The Environmental Education Guidebook

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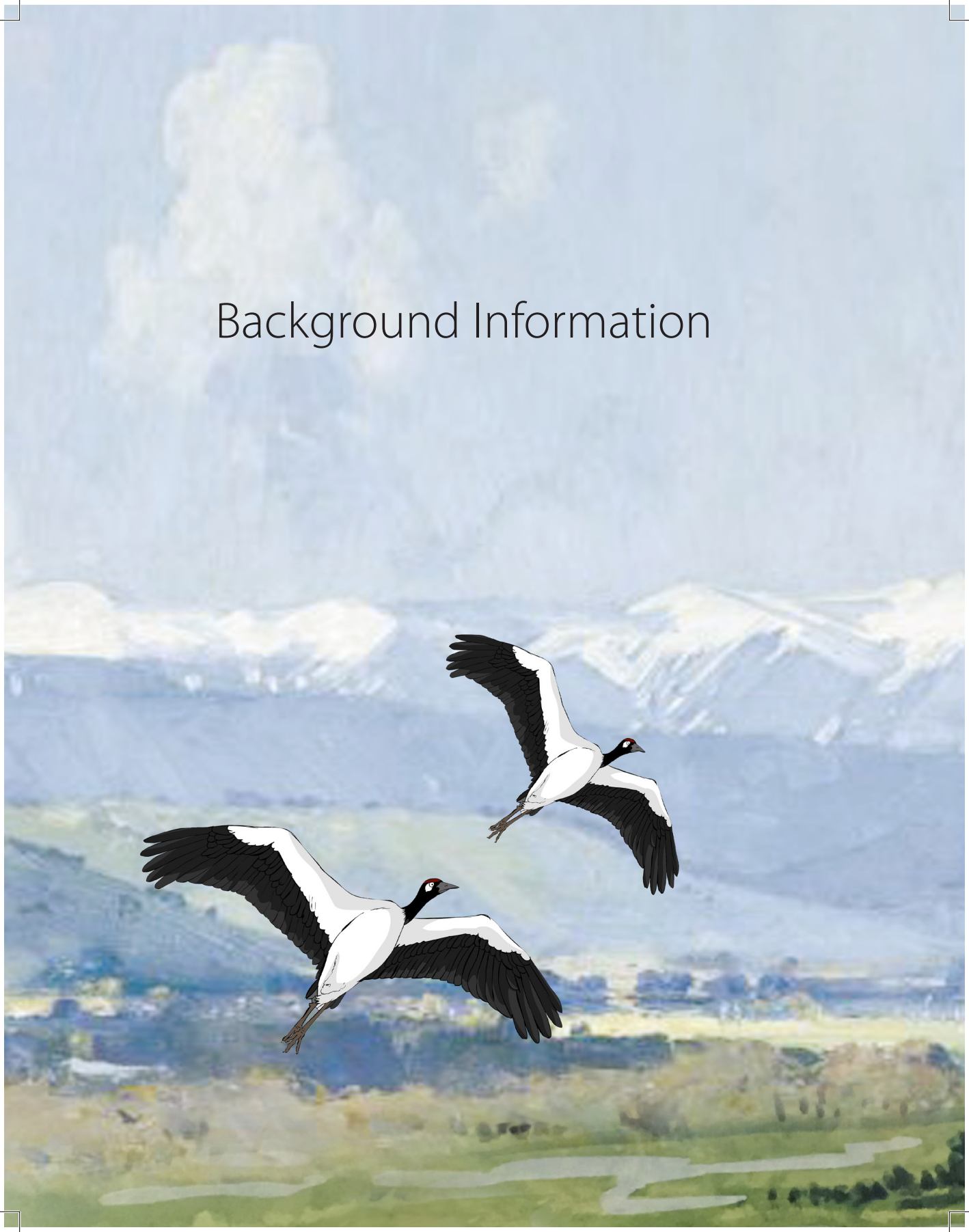
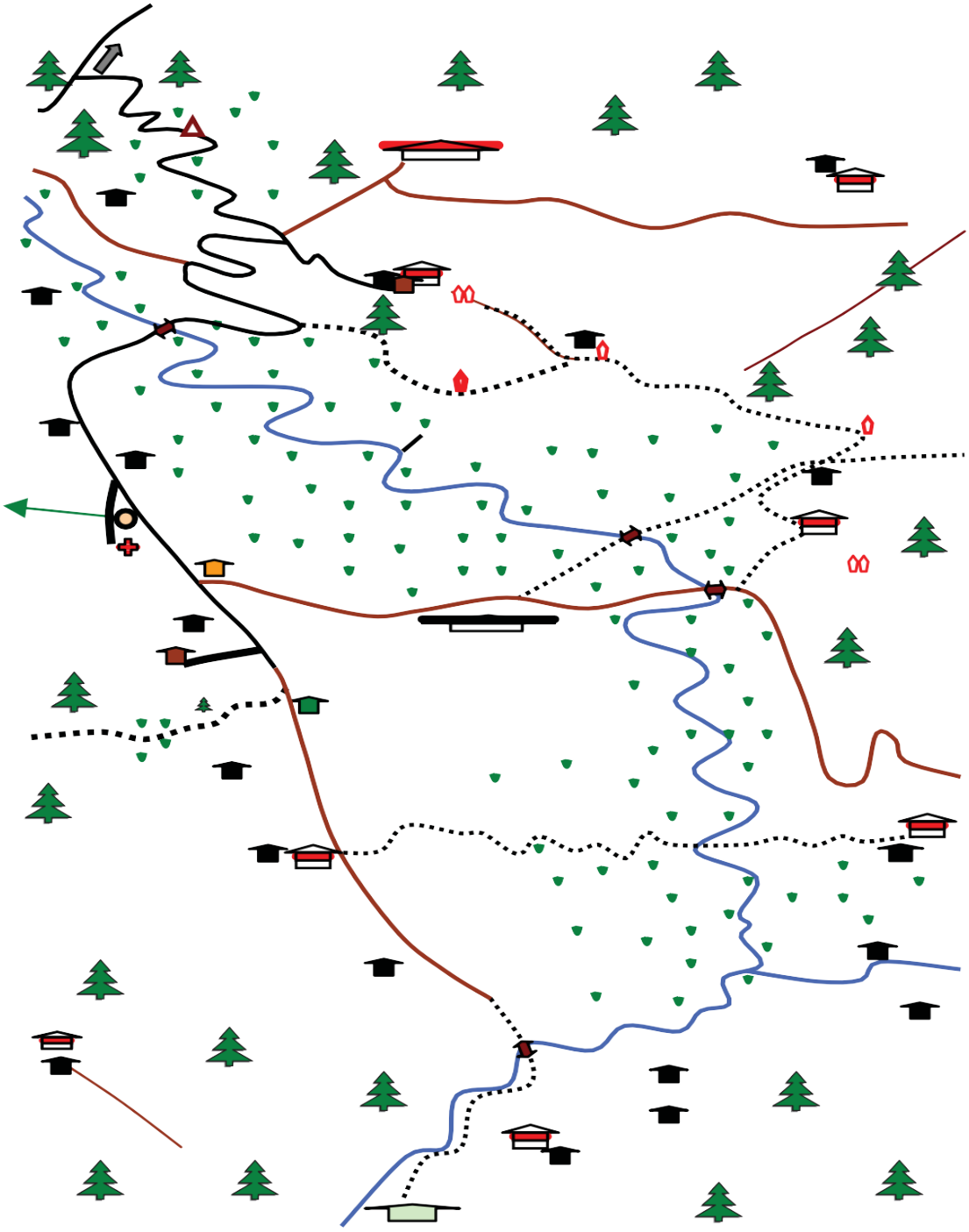




Introduction

Gangtey-Phobjikha valley lies at an altitude of 2900 meters above sea level on the periphery of Jigme Singye Wangchuck National Park, Wangdue Phodrang Dzongkhag. The valley is an important conservation site mainly because of the high altitude wetland formed by periglaciation actions in the past, which now serves as the wintering ground of the Black-necked Cranes, a vulnerable bird species. Due to its conservation significance, the valley was designated as Ramsar site (List of Wetlands of International Importance) in 2016. Additionally, there are a number of other important birds and animal species living in close association with the wetland, the forests and other ecosystems. While the valley is also home to over five thousand people, its panoramic landscape and wildlife attracts an increasing number of national and international visitors every year.

This book intends to introduce and educate the participants (visitors, locals and youth) on the natural environment of Gangtey and Phobjikha. It seeks to generate interest and love for nature through experiential learning, encompassing simple action research and outdoor exploration.

More specifically the book expects to:

i) build a sense of concern, values and knowledge on natural environment.

(ii) develop basic skills to assess and identify water quality, plants and animals.

This book contains fifteen specific activities for the participants to learn about the ecosystem of Gangtey and Phobjikha, and is intended be used as a guide by the teachers. There are checklists, record sheets and journals to facilitate the learning objectives following each activity. In addition to an experiential learning about its natural heritage, we expect participants to contribute to its conservation through data collection (eg. bird counts), surveys (eg. water tests) and other information related to the ecology, flora and fauna and issues in the valley.

Outline of the book

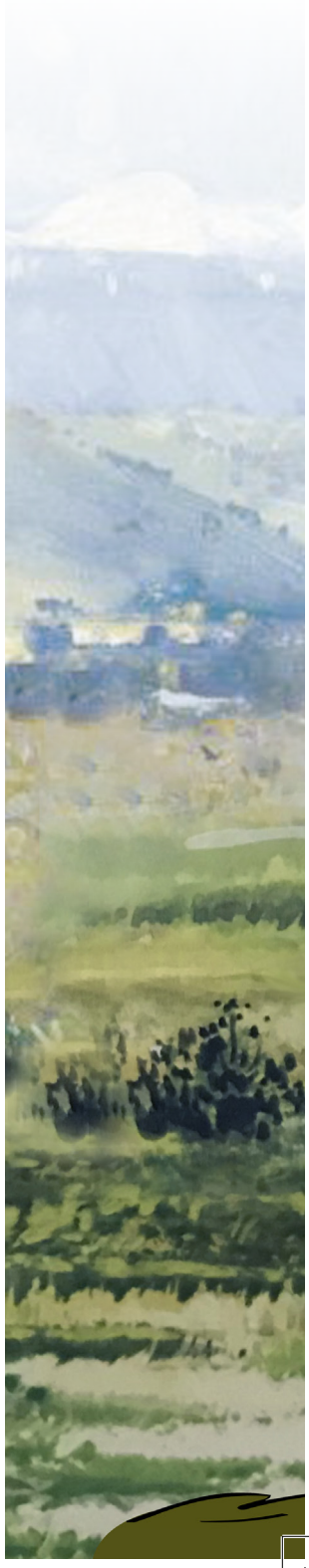
The activities in the guidebook are organized in the following manner:

- The background offers a basic introduction to the subject of the activity often describing why the particular activity is important.
- Did you know? is a section on fun and interesting facts about some of the subjects of the activity that may attract the attention of an individual.
- The objectives are the expected learning outcomes at the end of the activity.
- Keyword is an attempt to build the vocabulary of participants on ecology and ecological terms.
- Material and equipment are things needed in order to carry out the activity. The school must be able to provide the equipment.
- Time required is amount of time the entire activity should take but is only an approximation. It may vary from participant to participant.
- The activity process section explains a step by step guide to carry out the activities including tips.
- Recommended materials are reference guides that are needed such as plant and bird identification tools, record sheets, and visuals necessary before or after the activity.

General Outdoor Etiquette

As you take participants into the wilderness or the wetland, it is a good idea to speak with them first about how people should behave when they are outdoors and especially on wild quests to maintain ecosystem integrity and for the safety of the participants. This is also a good time to start instilling environmental ethics and behaviour in children, youths and adults reinforcing it if they are aware of it already.

- ***Be as quiet as possible:*** In order to get the most out of the activity, to hear birds and animals, and even to be able to see better, it is important to speak and move as quietly as possible.
- ***Always put natural items back where you found them:*** If you scoop for macro invertebrates, return them to the same area from where you got them when you are finished with the activity. If you dig a hole, place the soil back when you are finished. If you turn over a log to look for invertebrates, place it back when you are done.
- ***Handle with care:*** If you handle any animals, handle them carefully, including macro invertebrates and amphibians. Animals may be more fragile than we realize when handling them and most are sensitive.
- ***Pick up any litter you see:*** Carry a garbage bag to collect litter from the trails. Do not leave any litter behind. As participants visit the Gangtey-Phobjikha Conservation area, it is yours and their responsibility to keep the site as clean as possible.
- ***Tread carefully:*** Try not to walk on vegetation as far as possible. If you must walk through plants, have the group walk in a line to minimize the impact they will have on the fragile ecosystems.
- ***'Take only memories and leave only footprints'*** is a great etiquette to apply here. No samples of plants and animals are allowed without prior approval under the laws of the Kingdom of Bhutan.



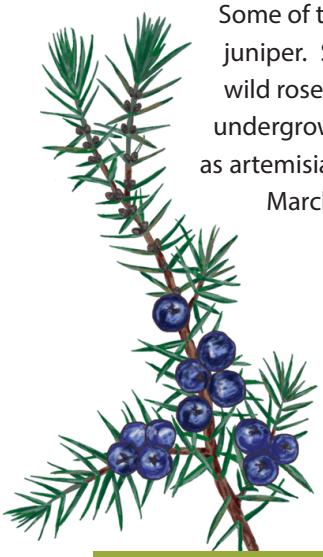
Activity Guide

01 Activity
Botany in a Day

Background

(You do not have to be a botanist to take part in this hunt for native trees and plants)
Common trees, shrubs and herbaceous plants of Gangtey-Phobjikha Valley

Native trees and plants play an important role in the ecosystem as a habitat, as a source of food and as part of the food web. Gangtey-Phobjikha valley has a diverse plant community owing to its altitude, geology and climatic factors. Some of the common trees are blue pine, fir, spruce, birch, maple and juniper. Several rhododendrons species, dwarf bamboo, daphne, wild roses are some of the more common woody shrubs occurring as undergrowth, and a number of common medicinal herb species such as artemisia, rhizome, delphinium, potentilla and gentians bloom from March through November.



Did you know?

- There are about 20,000 tree species and more than 300,000 plants in the world.
- *Rhododendron bhutanenses* is endemic to Bhutan, which means it is found only in this country.

Equipment needed:

- References, magnifying glass, wet boots, notebook, pencils, camera (optional), rain gear.

Time required:

- Two to four hours walk along the nature trails in search of trees, shrubs and herbs.

Objective(s):

- Learn about the native trees and plants of Gangtey-Phobjikha valley.
- Learn basic plant identification skills using pattern methods.

Keywords:

- Ecosystem, botany, abiotic, aerenchyma, food web, adaptation, endemic.

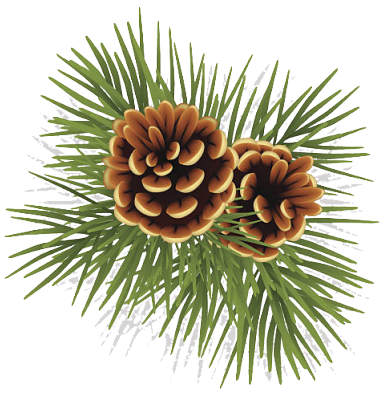
Activity process:

- All participants are required to gather for a short talk or visual presentation on botany of the valley including a basic guide to identifying plants.
- In the presentation include dos and don'ts, basic etiquettes and safety measures while in the valley.
- Hand out record sheets and plant checklist.
- Lead a guided walk along designated trails to go on a wilderness quest for trees and plants.
- When you approach a new plant ask if anyone knows the name of the plant. If they do, ask them to name it and how they know it.
- If there is time and the group has field guides, let them individually or as a group try to identify the plant using the field guides.
- Keep in mind the goal is not just to tell the name of a plant but also to give participants the tools to identify plants.
- Point out features about the plant that will help them recognize such as the leaf structure, stem, flower, fruit and seed.
- Note similarities and differences in relatives of the plant that have similar appearance.

- Observe the type of location where the plant is growing such as under tree canopy, in water, in a marsh, etc.
- Make sure that the participants get maximum practice and participation.
- Ask individual walkers to fill out the record sheets as they identify each plant or tree using the guidebooks.
- Encourage relevant questions.
- After the activity, ask participants to enter data into the record sheets and hand it over to the teacher..
- Participants can note in their journals (optional).
- Discuss the day's events.

Recommended resources:

- Presentation on the biodiversity/ecology of Gangtey-Phobjikha with specific focus on trees and flowering plants (include wetland plant adaptation)
- Botany in a Day by Thomas J. Elpel
- Photo reference book to Flowers of Bhutan
- Reference book to trees and flowers of Gangtey-Phobjikha (optional publication)
- Checklist (a list of trees and flowers to look out on your walk)
- Record sheet
- Journal (optional)



Activity 02
Wild flower Walk

Background

Native wild flowers bloom from early spring through late Autumn in Gangtey-Phobjikha valley. Many times, the common species of wildflowers are taken for granted in our quest for the rare and endangered ones. But these species are important indicators of how healthy the wetland, meadows and forests are in the valley.

This wild flower walk through the woodlands, marshes and alpine meadows is a treat for the botanical enthusiast. Depending on the time of the year, expect to see some of the more common native flower species of wild roses, primroses, rhododendrons, gentians, orchids and many other alpine herbaceous plants.

Did you know?

- In a food chain, plants are called primary producers of energy.
- There are carnivorous plants which feed on insects and other small animals.
- A rhododendron species endemic to Bhutan is the *R. kesangiae* named after the Her Majesty Ashi Kesang Choden Wangchuck, the Royal Grandmother of Bhutan.
- The wetland shrubs are grazed by cattle and horses, keeping the height of the shrubs just right for the cranes to roost and feed.

Activity Process:

- Begin the activity with a short talk or visual presentation on the botany of the valley. Include a basic guide to identifying these plants.
- In the presentation include dos and don'ts, basic etiquettes and safety measures while in the valley.
- Hand out record sheets, plant checklist and spotting cards (optional).
- Lead a guided walk along the board walks and designated trails to go spotting for wildflowers.
- In spring through early summer expect to see some primroses, gentians, magnolia, rhododendrons, daphne, wild roses, and legumes in bloom.
- In late summer through autumn, expect to see some rare orchids, common late blooming flowers such as delphiniums, aconites, and many medicinal herbs.
- When you approach a plant, ask participants if they recognize the plant or a plant that looks like it.
- Observe the arrangement and colour of flowers, stem, shape and arrangement of leaves, height of flower, etc.
- Note down observation and if possible, make a sketch or take photographs for identification.
- Ask individuals to fill out the record sheets as they identify each flowering plant using the guidebooks.
- After the walk, discuss the day's events, experiences and issues that may have come up.
- Optionally, ask participant to write their journals.

Equipment needed:

- Hand held magnifying glass, wet boots, card packs, rain gear, notebook, pencil.

Time Required:

- Two to four hours walk along the nature trails.

Objective(s):

- Introduction to botany vocabulary.
- Learn basic skills to identify wild flower and their habitats.
- Connect to the natural world of flowering plants.

Keywords:

- Botany, botanist, adaptation, endemic species, composite, food chain.

Recommended materials:

- *Shanleya's Quest (a book on pattern method plant identification for children)*
- *Spot the wildflower*
- *Basic guide to identifying trees and plants*
- *Wild Flower Record sheet*
- *Checklist*
- *Journal*

Plant and Wildflower Record Sheet

Site Name:			
Date:			
Weather Condition: (please tick) Sunny, Cloudy, Partly Cloudy, Rain, Snow, Windy.			
Temperature (In Degree Celsius)		**Season:**	
Please record your sightings and observations in the table below			
Name of Plant *(Include local names if available)*	**Type of Plant (***Tree, Shrub, Herb, Grass, Fern, Mushroom)*	**Habitat Type** *(Wooded, grass-land, marshy, stream side, alpine meadow)*	**Observations** *(Budding, Flowering, Seedling, Shedding leaves)*

Wild flowers and Plant Journal

1. Note location, date and time: You will want to be able to look back at your nature journal and know exactly when and where you were when you observed each entry.

Location: Date/Time:

2. Record your observations with drawings/sketches. It will help you observe better and focus on the details of the plants such as the shape of the leaf, its texture, flower and leaf arrangements, stalk height etc. Alternatively, take photographs.

3. Note down your observations and add how you felt at the time of observation. Describe the size of the plant, colour and texture of leaves, stem/trunk, and flowers. Imagine the role it plays in the ecosystem and describe it.

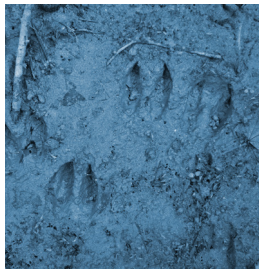
4. Note any other observations and issues.

5. Learn more about the plants at home using online resources, libraries and books.

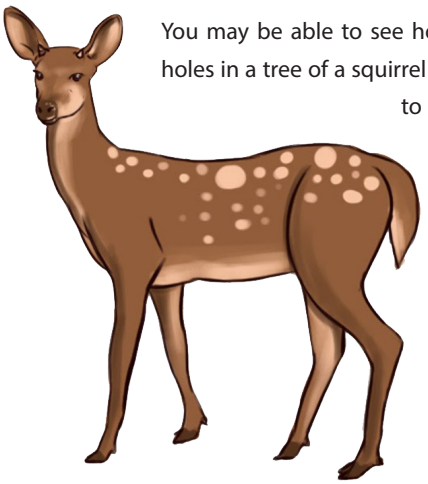
03 Activity
Follow the Tracks

Background Information

Wherever animals are found, they leave behind clues or signs about 'who' they are, and 'what' they were doing when they left the sign. While it is difficult to see wildlife especially that of elusive birds and mammals, tracks are one of the most common signs to determine the animal species and the direction it was moving. One of the best places to spot tracks is in the muddy areas, around the edges of streams, soft soil, sands or snow.



Another clue animals leave behind are scats or droppings. From scats, you can determine the species and what they ate.



You may be able to see homes of wildlife such as a cave of a bear, holes in a tree of a squirrel or beds of matted grasses. Yet other clues to identifying and surveying the presence of wild animals are food they eat (eg. carcass), feather or fur, bones or teeth and eggshells.

Modern technology such as a night vision camera trap allows photographs of very elusive wild animals such as a tiger or a leopard.

Did you know?

- Langur monkeys live in groups consisting of 11 to 60 monkeys. The group is dominated by a high-ranking male.
- Musk deer is one of the highly poached and endangered animals in Bhutan.
- The barking deer or muntjak gives calls similar to barking, usually upon sensing a predator (hence the common name for all muntjaks or barking deer).

Equipment needed:

- Plaster, cast, metal rings, small measuring tape, wet boots, rain gear, notebook, pencil, camera and GPS instrument. (Optional)

Time Required:

- Two to four hours in the field.

Objective(s):

- Learn basic animal tracking skills
- Know the web of life in the valley

Keywords:

- Scats, claws, carcass, elusive.

Activity process:

- Tracking is best done early morning or late in the day when shadows make prints easier to see.
- Brief participants on dos and don'ts and basic etiquettes to follow while in the valley tracking wildlife.
- Hand out a checklist of mammals and a record sheet before heading out.
- Lead the group along the designated nature trails and boardwalks keeping a close look out for tracks in the mud, soft soil or snow and any other signs of wildlife such as scats (droppings), feeding habits (clipped vegetation, carcasses), and habitat etc.
- Note the size of the track and whether it shows claw marks. You may wish to make a sketch.
- Discuss and identify tracks, scats or markings.
- If the track belongs to an unusual or elusive, rare animal, make a plaster cast. To do this, place the plastic ring around the track to keep the liquid inside the ring. Follow instructions on the Plaster for preparation. Pour at the edges and let it flow toward the center. Let it dry for 30 minutes; dig out the mud below for the cast to be lifted safely.
- Walk back to the place where it had begun. Ask participants to gather to discuss the questions such as what animal made the tracks? What was it doing there? Where did the animal come from? And why did it go through here?
- Journaling is an option for participants. Hand out journal sheets to interested individuals to write down the events of the day.

Recommended materials:

- Peterson Field Guide: Animal Tracks by Olaus J. Murrie
- Checklist of mammals
- Record sheet

Mammal record sheet

Site Name:			
Date (DD/MM/YY): Season: Spring Summer, Autumn Winter			
Weather Code: (please tick) Sunny, Cloudy, Partly Cloudy, Rain, Snow			
Temperature (In Degree Celsius)			
Common Name	**Scientific Name**	**Evidence** *(Sighting, scat, pug mark, browse pattern, hair, carcass, call)*	**Habitat Type** *(Woodland, marsh, open field, agriculture field, marsh, stream)*
Barking Deer			
Civet Cat			
Common Leopard			
Crab eating mongoose			
Dole			
Goral			
Himalayan Black Bear			
Orange bellied Squirrel			
Pika			
Sambar deer			
Three stripe Himalayan Squirrel			
Wild Pigs			
Yellow-throated Martin			
Otter			
Porcupines			
Cattle			

Mammal Field Journal

1. Note location, date and time: You'll want to be able to look back at your nature journal and know exactly when and where you were when you observed each entry.

Location Date/Time

2. Record your observations of mammal or signs of animals (tracks, calls, droppings, hair, carcass, homes etc.) with drawings/sketches.

3. Describe the animal in your own words and add how you felt at the time of observation. If you notice signs, imagine what it could have been doing there. Is it a predator or a prey to what animal? What role does it play in the ecosystem?

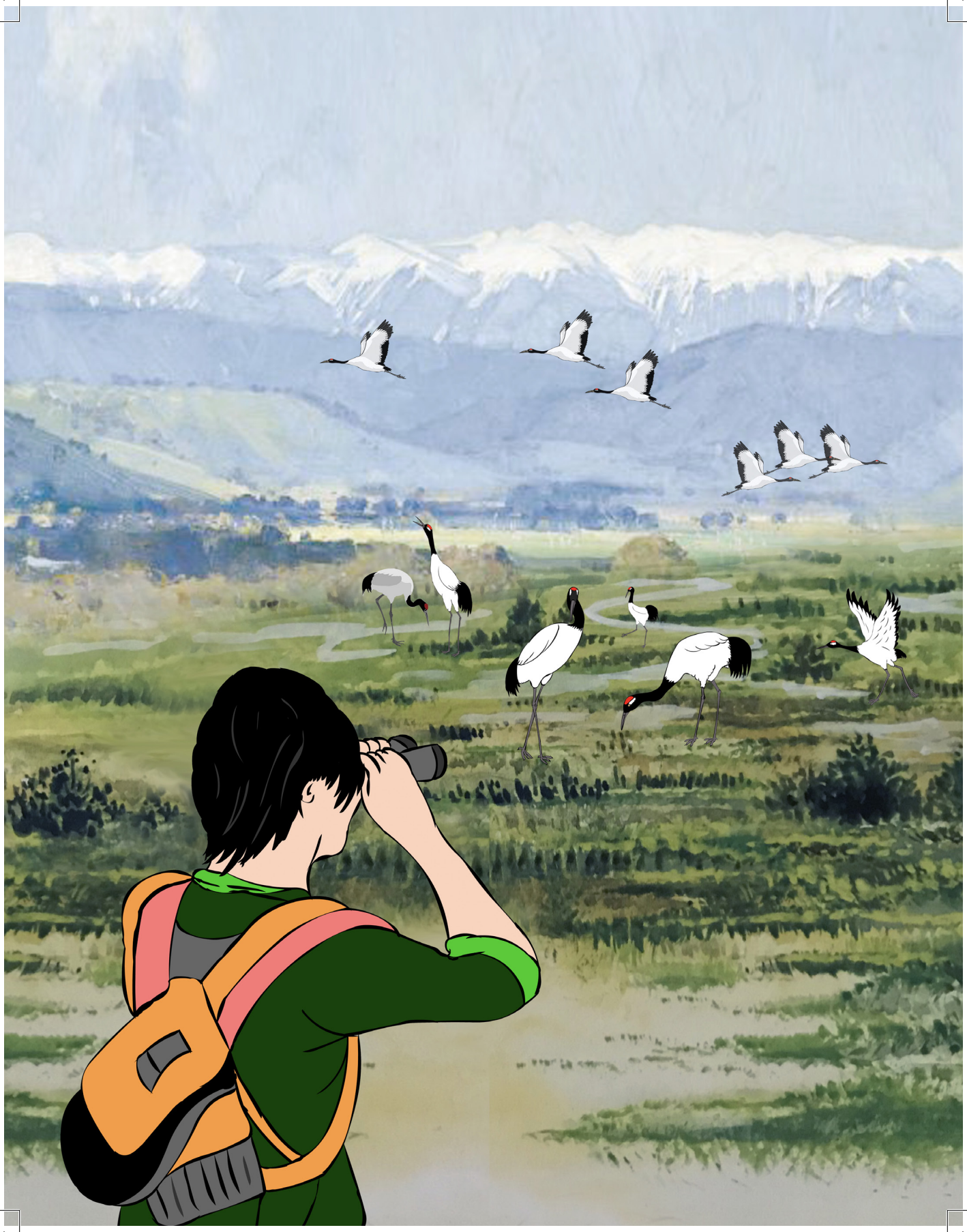
4. Write down any other observations and issues that you noticed.

04 Activity
Bird Watching

Background information

In the ecology, birds are an important indicator species and play a vital role in pollination and the food web. This relationship with the ecosystem and the changes in bird population can tell a story about the health of that environment. Birds make good indicator species because they are relatively easy to spot and different birds species require various habitat for feeding, breeding, migrating and wintering.

In Gangtey-Phobjikha valley, the Black-necked Cranes are the flagship species and a good indicator of the integrity of wetland. Besides, there are over 93 bird species recorded in the area including a few rare species to spot (RSPN survey, 2011).



Did you know?

- There are around 10,000 different species of birds worldwide.
- Their bones are hollow which makes them light.
- A light body allow them to fly faster, using less energy.
- Ornithology is the study of birds and people who study it are called ornithologists.

Equipment needed:

- Binoculars, spotting scopes, spot the birds card, wet boots, rain gear, and bird checklist.

Time required:

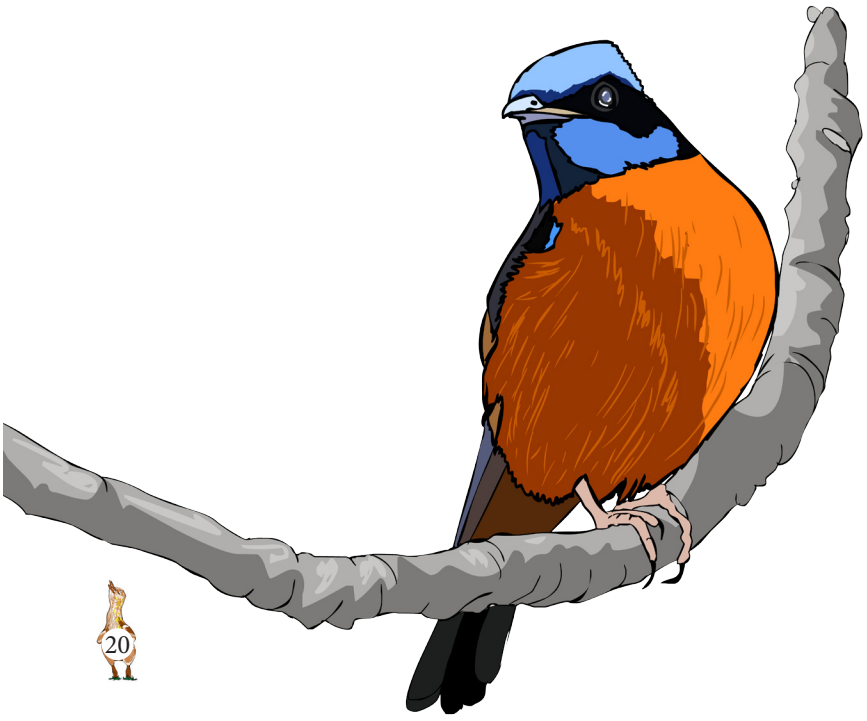
- Two to three hours walk along the nature trails to spot birds.

Objective(s):

- Develop vocabulary on ornithology
- Learn basic skills on bird monitoring
- Connect to the natural world of birds of Gangtey-Phobjikha

Keywords:

- Monitoring, ornithology, wing span, threatened, endangered species



Activity process:

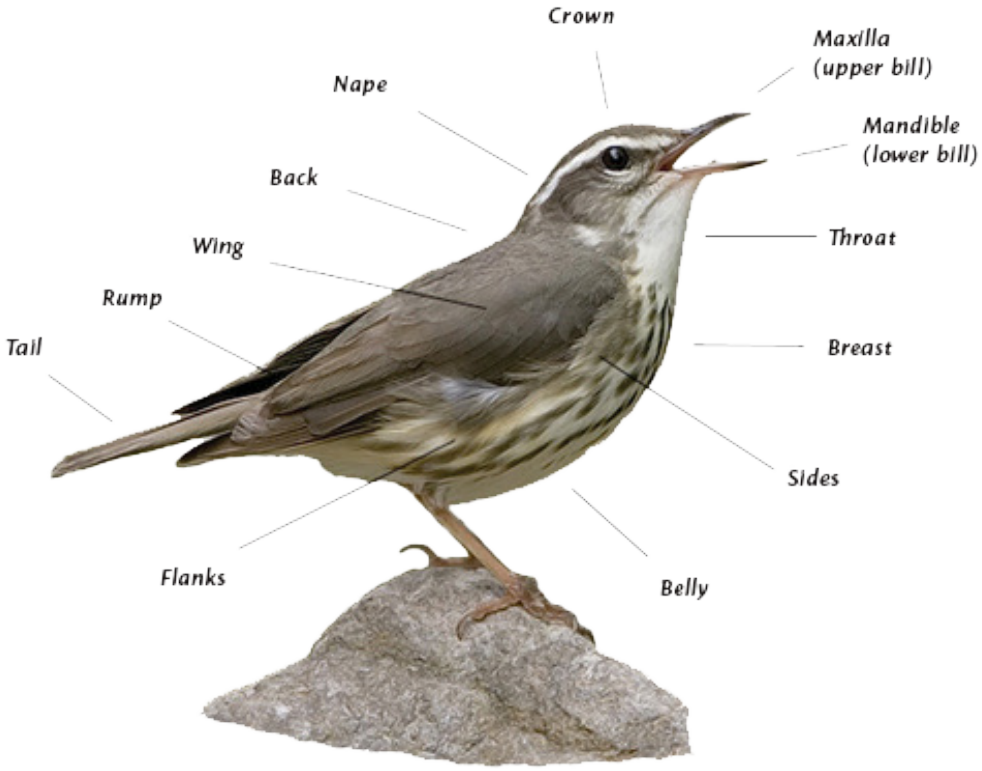
- Ask participants to gather for a short visual presentation or talk on the ecology of the valley focusing on birds of Gantey-Phobjikha.
- Hand out bird record sheets with a checklist of birds of Gantey-Phobjikha.
- Take a guided tour along the nature trails with a checklist of birds to spot, binoculars, GPS instrument (Optional) and bird guidebooks.
- If a member spots a bird or hears a call, stop to identify, observe and count.
- Ask the group to note the size of the bird. It could be the size of a sparrow, a common myna, an eagle or a crow.
- Ask participants to observe the shape of the bird. It may be plump or round like a pheasant or slender like a thrush, it may have a long neck like a crane or short, it may have long legs or short legs. Ask members to note it down.
- Note the shape, size and colour of the beak. It is different for different birds depending on the food they eat.
- Note the dominant colour in each part of the bird.
- Ask them to note the location of where the bird was observed such as on a tree, bush, land, building etc.
- Once the group has this data, gather around to see a possible match in the bird guide or the checklist.
- Gather the group to discuss experiences and issues. Collect the record sheets or ask members to enter data on journals.

Recommended resources:

- Presentation and slide show on birds of Gangtey-Phobjikha
- Birds of Bhutan
- Peterson's field Guide: Young Birder's Guide
- Bird checklist
- Journal

Bird Identification Tips:

- Predominant colour: Is it yellow like a finch or mostly black like a crow?
- Comparative size: Is it small like a tit, medium like a thrush or large like a crow?
- Body shape: Is it round and plump like a pheasant or sleek and long like a magpie?
- Bill shape, size and colour: Is it short and curved like a hawk, or long and slender like a crane?
- Wing shape: Is it pointed like a swallow or broad like a hawk?
- Flight pattern: Is it flying up and down, hovering, undulating, bobbing, or gliding?
- Unique habits: Is it pecking at wood like a woodpecker or hovering in mid air to spot rodents like a common kestrel?
- Nest site materials: Is it made of twigs, grass, feathers, fur, lichen or is it a hole in a tree?
- Foot details: Is it webbed like a duck?



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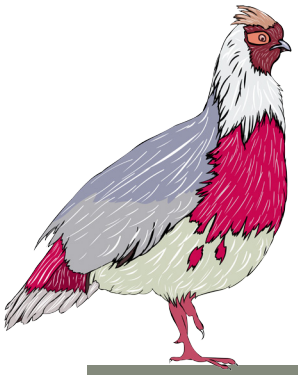


Activity 04
Bird Monitoring

Background

Depending on the choice of trail, the two to four hour hike around the valley will introduce participants to some of the most common resident and migratory bird species. The more common species to spot are pheasants, tits, snipes, swifts and griffon. Ducks (Ruddy shelduck) and cranes (Black-necked Crane) are winter migrants in the valley.

Equipment needed:

- Binoculars, spotting scopes, wet boots, rain gear, and bird checklist.

Time Required:

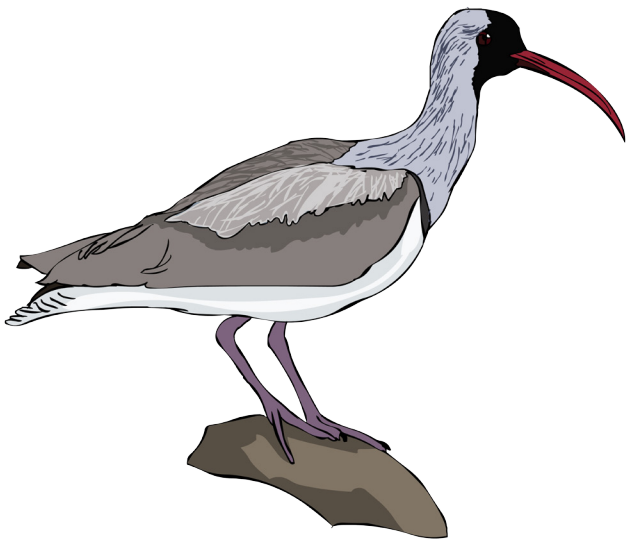
- Two to three hours walk along the nature trails on bird monitoring

Objective(s):

- Develop vocabulary on ornithology
- Learn basic skills on bird monitoring
- Connect to the natural world of birds of Gangtey-Phobjikha

Keywords:

- Ornithology, wing span, monitoring, threatened, endangered species.



Activity Process:

- Hand out bird record sheets and spotting cards (optional) with a checklist of birds of Gantey-Phobjikha.
- Take a guided tour along the nature trails with a checklist of birds to spot, binoculars, GPS instrument (optional) and bird guidebooks.
- Expect to see the Black-necked Cranes in winter along with snow pigeons and migratory birds such as the Ruddy shelduck. Some small marshland birds, pheasants and predator birds are common in early spring through late summer and Autumn.
- If a participant spots a bird or hears a call, stop to identify, observe and count.
- Encourage participants to identify the bird through its call, shape, size, colour.
- Ask participants to record temperature, GPS coordinates, and time of the day etc in the record sheet. (optional)
- Observe the behavior, location and site description for participants to note it down.
- Gather group at the class room to discuss experiences and issues.
- Collect the record sheets or ask participants to enter data on the journals.

Recommended materials:

- Presentation and slide show on birds of Gangtey-Phobjikha
- Peterson's Young Birder's Guide
- Bird checklist
- Birding Journal
- Birds of Bhutan booklet (optional publication)

Bird Record Sheet

Site Name:			
Date (DD/MM/YY):			
Weather Code: *(please tick)* Sunny, Cloudy, Partly Cloudy, Rain, Snow			
Temperature *(In Degree Celsius):*			
Please record your sightings in the table below along with number of each species observed			
Common Name	**Scientific Name**	**Number** *(No. of birds observed)*	**Activity Observed** *(Feeding, courting, mating, basking, singing, flying, nesting)*

Birding Field Journal

1. Note location, date and time: You'll want to be able to look back at your nature journal and know exactly when and where you were when you observed each entry.

Location: Date/Time:

1. Record your observations with drawings/sketches focusing on the details of the bird, its shape, size, dominant colour, flight pattern, beak type etc. Include the habitat and backdrops such as mountains and valleys. Is it a predator or a prey to what animal? Imagine and describe what role it plays in the ecosystem.

2. Note down your observations and add how you felt at the time of observation. Describe bird behaviors, its shape, size and colour. Add a description of its sound or call and number of birds observed.

3. Note any other observations and issues.

4. Learn more about the plants at home using online resources, libraries and books.

06 Activity
Count the Cranes

Background

Also called the Tibetan crane, the Black-necked Crane or *Grus nigricollis* (*Grus=crane, nigri=black; collis=neck)* has a black neck, head and lower parts of the wings and tail. It has a small white patch to the rear of the eye and a red bald patch between the bill and the eye. The rest of the body is grey. Juveniles are smaller in size and greyer.

There is an estimated 10,000-10,200 (ICF) individuals of the Black-necked Cranes ranging from Qinghai-Tibetan Plateau and Yunnan-Guizhou Plateaus in China, some parts of Arunachal Pradesh and Ladakh in India and Bhutan. In the world, the International Crane Foundation monitors the Black-necked Crane migration and population.

In Bhutan, the Black-necked Cranes are found in Gangtey-Phobjikha and Khotokha in Wangduephodrang, Bumdeling in Trashi Yangtse, and Geytsa in Bumthang valley. As the wintering grounds, Black-necked Crane habitats(except Geytsa in Bumthang) in Bhutan are protected formally under the Ramsar Convention. Listed under Schedule I of the Forest and Nature Conservation Act of Bhutan, the bird has acquired a celebrity status among the Bhutanese and international communities alike.

Every year on November 11, the Annual Black-necked Crane festival is held in Gangtey-Phobjikha as an occasion to welcome the birds to Bhutan and celebrate its significance for conservation and culture.

Why do we count the cranes?

Counting each individual bird can be a challenge, but it can also become valuable information for scientific research and researchers who work for conservation of these cranes. Over the years, if population of cranes change, those fluctuations may indicate the status of conservation, shifts in pollution levels, climate change, loss of habitat, migration timing and much more.

Did you know?

- There are fifteen species of cranes in the world including the Black-necked Crane.
- The Black-necked Crane was the last crane species to be discovered by scientists. A Russian naturalist called Count Przewalski discovered it in Lake Koko Nor in North Eastern Tibet in 1876.
- The Black-necked Crane is the only alpine crane in the world.
- Cranes usually stay with the same mate all their lives and lives up to 30 years on average in the wild.
- A Siberian Crane lived up to 83 years in captivity.
- In Bhutan, the crane is considered a Ihabja or a sacred bird; and in Japan it is considered 'the bird of happiness'.

Equipment needed:

- Binoculars, spotting scope, wet boots, camera (optional), GPS (optional), pencils/ pens.

Time Required:

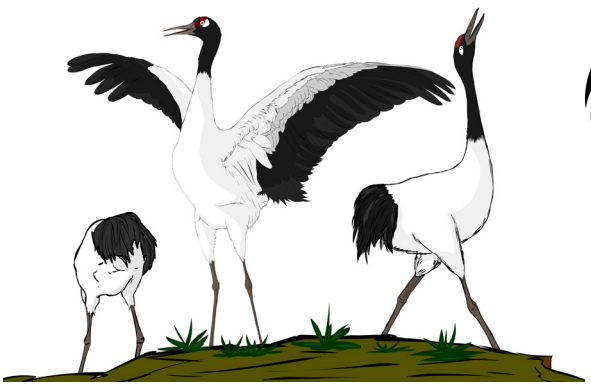
- One to two hours at the photographic hide or any vantage point

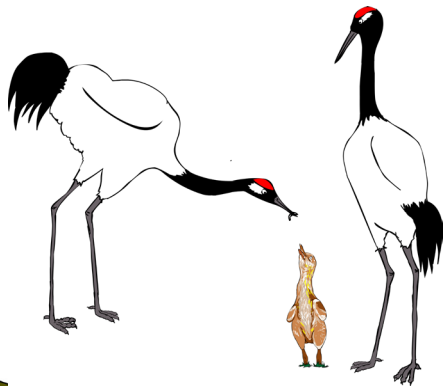
Objective(s):

- Engage in crane monitoring and contribute to its conservation
- Develop basic crane counting skills
- Connect to the natural world of the Black-necked cranes

Keywords:

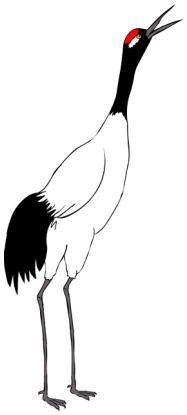
- Monitoring, banding, migration

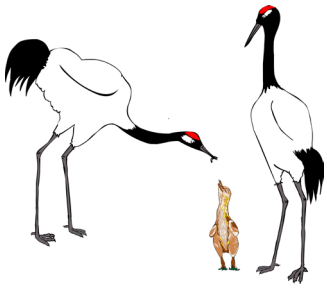




Activity Process:

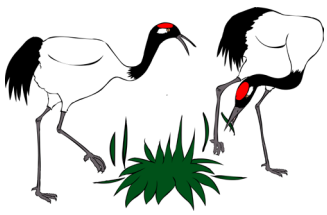
- Ideally, crane counts are done in the evening just before they arrive at the roost for the night or in the morning before they fly off to feed in different areas.
- Conduct a visual presentation or talk on the ecology of Gantey Phobjikha, its significance as a conservation area and a habitat for the Black-necked Cranes.
- Present a brief on the dos and don'ts especially highlighting crane's sensitivity to participants (human or animals).
- Include a short video on cranes, its ecology and the relationship with the communities.
- Hand out the crane count/record sheets.
- After the briefing, take note of the regular crane hours and lead the group to a photographic hide or a designated vantage point from where they can easily spot the cranes.
- Do a point count while flying out to feeding areas in the morning or at the time of flying back to roost in the evening.
- Keep a note of the discussions.
- Another visual on crane migration and monitoring through telemetry transmitters and banding may be viewed but should be optional.





Reference materials:

- Crane count record sheet
- Guide to crane behavior (courtesy of the International Crane Foundation)
- Journal



Crane Count/Record Sheet

Name of Observer:		**Location:**		
Date (DD/MM/YY):		Start Time:		End Time:
Weather Code: *(please tick)* Sunny, Cloudy, Partly Cloudy, Raining, Snowing				
Temperature *(In Degree Celsius):*				
Please record counts in the table below. Use a tally sheet if required.				
Time	**Adult**	**Juvenile**	**Total Count**	**Remarks**

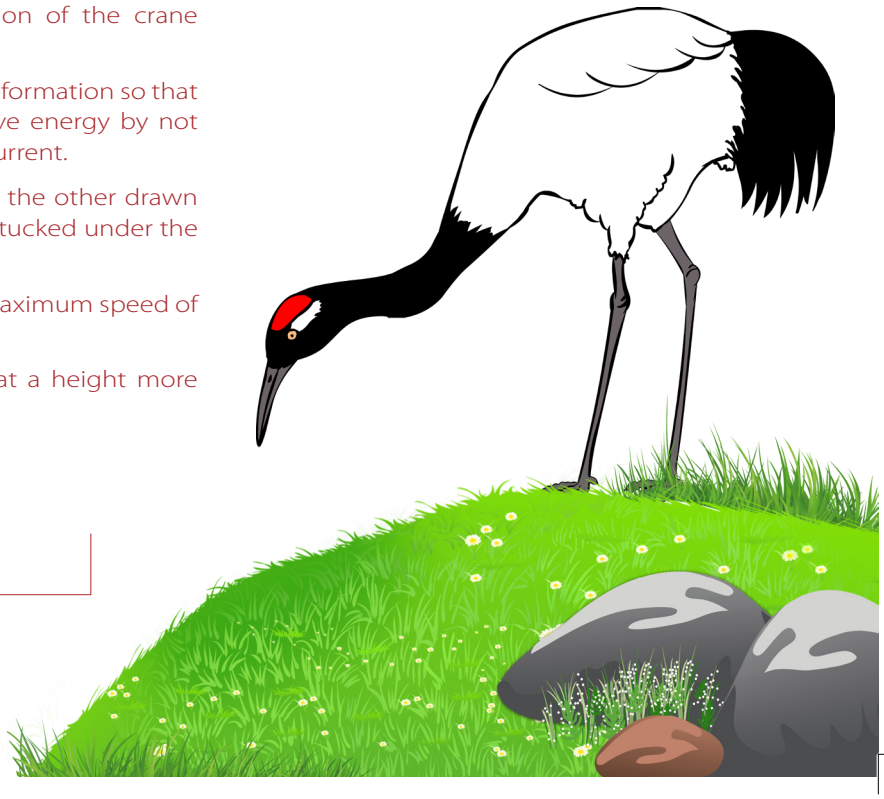
07 Activity
Crane Behaviors

Background Information

Ethology is the study of animal behavior and people who study them are called ethologist. It is interesting to study crane behavior including their dance, body language, and vocalizations to understand the different ways they communicate. Crane dances or mating behaviors are especially spectacular to observe as they bow and bob, throw their heads back and trumpet, throw mud, stones and feathers into the air, and leap up and down.

Did you know?

- RSPN banded three cranes, Phobjib, Gangteb and Jigme to track their migratory routes to their summer breeding grounds.
- The victory dance in a traditional Bhutanese archery match is an emulation of the crane mating dance.
- Cranes fly in an echelon or a V-formation so that birds following the leader save energy by not having to push aside the air current.
- Cranes sleep on one leg with the other drawn up to the body and the head tucked under the wing.
- Black-necked Cranes fly at a maximum speed of 90km per hour
- Black-necked Cranes can fly at a height more than 20,000 ft (6096mtrs).



Equipment needed:

- Binoculars, spotting scope, wet boots, camera (optional), GPS (optional), crane behavior guide.

Time Required:

- One to two hours walking toward the blind and counting process

Objective(s):

- Develop skills to observe crane behavior
- Learn about crane communication

Keywords:

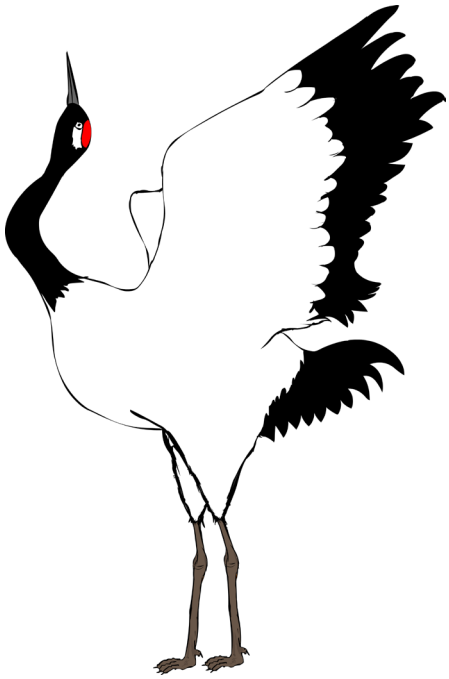
- Ethology, vocalization, mating, breeding, echelon

Activity Process:

- Introduce participants to Gantey-Phobjikha valley through visual presentation and/or talks. Include a video of cranes.
- Introduce participants to crane behavior, identification between adult and juvenile.
- Include in the presentation, dos, don'ts and basic etiquettes to follow explaining how cranes are sensitive to any visitor (human or animals) and be easily threatened.
- Begin observation and identification using available equipment at the observation room.
- Lead a guided walk along the wetland trails and boardwalks to a photographic hide or a designated vantage point in the feeding areas from where you can easily observe the cranes.
- At the site, carefully note threat calls, foraging and territorial habits and any other observable behavior.
- Try to spot and point out the difference between adult and juvenile cranes.
- Afterwards, gather in the classroom to discuss your experiences, observations and issues that you may have come across during the field trip.
- Another 20 minute visual on crane migration and monitoring through telemetry transmitters and banding is optional for viewing.
- Individual journaling is another option.

Reference Materials:

- Guide to Crane Behavior (Courtesy of ICF)
- Journal



Black-necked Crane Field Journal

1. Location Date/Time

2. Record your observations of crane behavior with drawings/sketches.

3. Describe your observations.

Activity 08
Paper Origami for Peace

Origami is the Japanese art of paper folding. An ancient Japanese legend has it that folding a thousand paper cranes will get your wish fulfilled by a crane. It is given as a gift to wish good fortune.

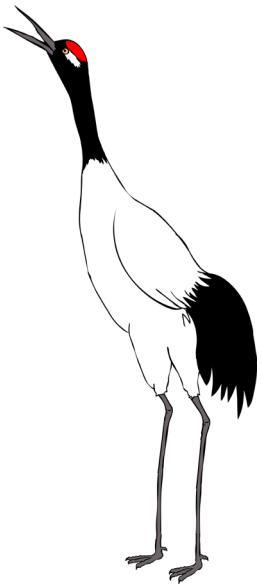
For both adults and children, folding paper cranes will introduce them to the natural world of cranes through visuals and storytelling.

Equipment needed:
- Origami paper and storybooks.

Time Required:
- One to two hours at the school.

Objective(s):
- Develop crane knowledge through talks and visual presentations
- Have fun with origami
- Learn about cranes and cultures while folding papers

Activity Process:



- Gather at the class room for a short presentation on Gantey-Phobjikha valley, its culture and ecology focusing on the Black-necked Cranes and its significance in the valley.
- Show a short visual on the cranes, its ecology, migration and relationship with the people of the Bhutan and the valley in particular.
- Introduce paper origami as an art. Follow instructions on the paper or screen to fold and continue discussions on cranes and cultures of the world.
- Alternatively, for younger participants, story telling is an art in itself. Ask participants to select storybooks and read folktales from Bhutan.

Recommended materials:
- Origami instruction sheets (courtesy of ICF)
- Videos on crane and culture for optional viewing
- Folktales from Bhutan

Origami: A simple guide to folding paper cranes

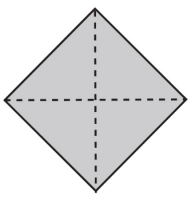
(Courtesy of the International Crane Foundation - www.savingcranes.org)

ORIGAMI CRANES

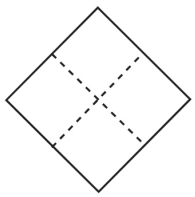
"Fold 1,000 paper cranes

and your heart's desires

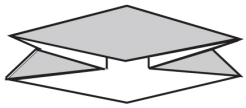
will be fulfilled..."



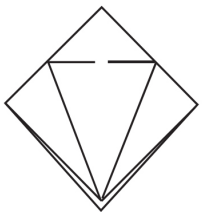
1. Using a square piece of paper, fold the paper in half to form a triangle. If using paper colored on one side only, begin with the colored side facing up. Unfold the paper and repeat f to make folds seen in the image above.



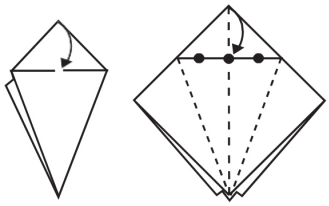
2. Flip the paper so the colored side is facing down and fold the paper in half forming a rectangle. Unfold the paper and repeat to make folds seen in he image above.



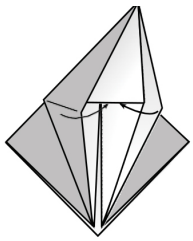
3. Now fold along all four creases at once to form a square with the open end facing you.



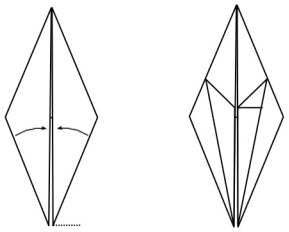
4. Fold two edges in, to form a kite shape on top. Repeat on other side.



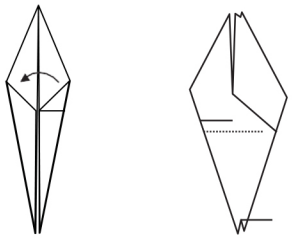
5. Fold the point down and crease above the other two folds. Flip the paper and repeat fold. Undo the folds you made in steps 4 and 5.



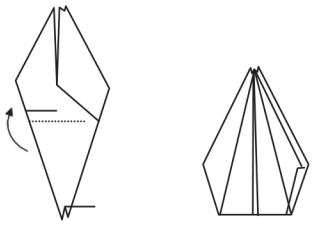
6. Pull the bottom corner (top layer only) up above the top corner. Fold along the creases you made in steps 4 and 5. Repeat on the other side.



7. Fold two edges in to form a kite shape. Repeat on the other side.

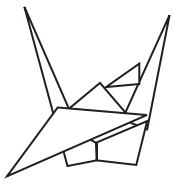


8. Fold the top layer (right side) to lay on top of the left side like turning the page of a book. Flip over and repeat on other side.

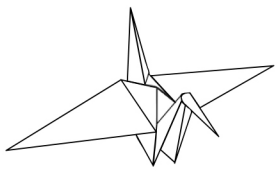


9. Fold up the top layer as far as you can on each side.

10. Fold the top layer (right side) to lay on top of the left side like turning the page of a book. Flip over and repeat on the other side.



11. Fold down wings.



12. Bend down the head to give the crane a long beak. Pull the wings straight out from the body so that the body inflates.

09 Activity
Amphibian Survey

Background information

Frog and toad calls are an important way to determine where different species occur and how populations are changing over time. Because most amphibians need both aquatic and upland habitats, they can serve as important indicators of water quality and other aspects of environmental health.

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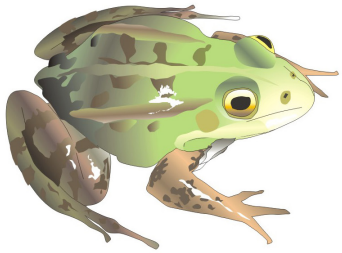
SIN COLA



RANAS

SAPOS

Did you know?

- Amphibians are the first land animals and appeared around 360 million years ago.
- Amphibians evolved from fish that had fleshy long fins that looked like legs.
- Special chemicals in frog skin help keep away infections.
- Frogs can leap forty times their length, can snag their food with a sticky tongue, swim with built- in "goggles," and grip tree trunks with their toes

Equipment needed:

- Hand-held magnifying glass, wet boots, hat, camera (optional), amphibian chart, GPS(optional), maps.

Time Required:

- One to two hours in the field

Objective(s):

- Learn about the life cycle of frogs and toads
- Develop basic skills in recording amphibians
- Learn about the importance of amphibians in the wetland

Keywords:

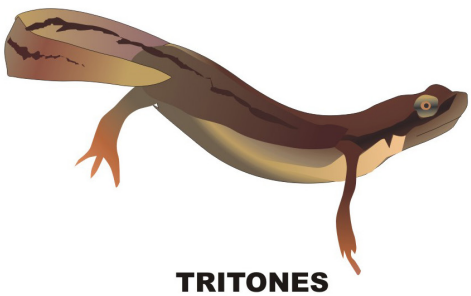
- Indicator, evolution, predators, basking, feeding

Activity Process:

- Conduct a short presentation on the ecology and culture of Gantey-Phobjikha valley with specific focus on the wetland and the significance of amphibians as an indicator of wetland and other environmental health.
- Each member of the group will receive an amphibian record sheet to help with recording the population and species of amphibians in the wetland and around the valley.
- Lead the group along the designated nature trails and boardwalks keeping a close look out for amphibians along the way.
- Listen to calls and when you spot one, Do Not touch. Amphibians breathe through their skin and are easily hurt by the warmth of our hands. It is also easy to damage them while trying to catch them.
- Walk across the habitat at a steady speed searching constantly and recording the number of animals seen on or by rocks, trees and bushes, and on bare ground.
- Record observed behavior, e.g. basking, feeding, nesting, running from predators, mating, etc.
- Lead the group back to the classroom to discuss and identify the species.
- Journaling is an option for participants.

URODELOS
CON COLA

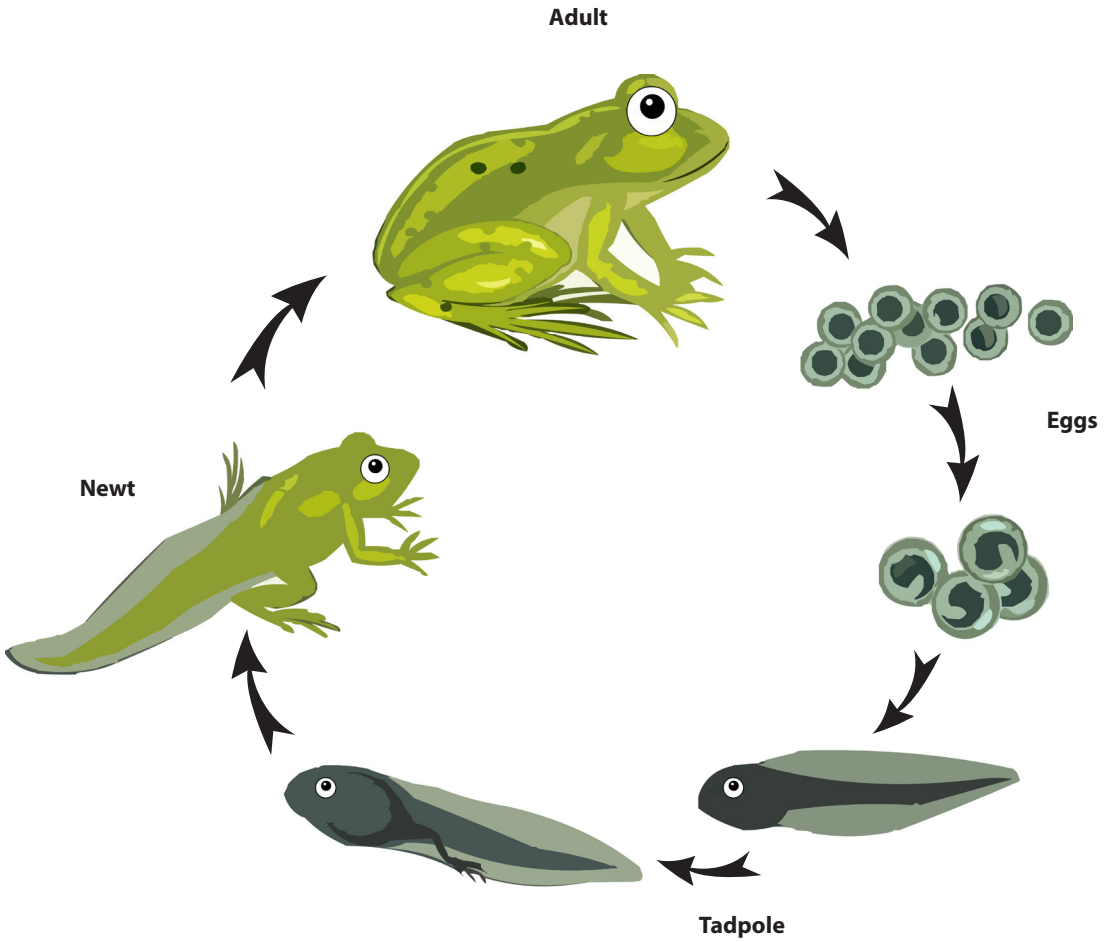
SALAMANDRAS



TRITONES

Recommended materials:

- Guide to amphibian survey
- Amphibian record sheet


Adult
Eggs
Tadpole
Newt

Amphibian record sheet

Site Name:			
Date (DD/MM/YY):		Season: Spring Summer, Autumn Winter	
Weather Code: *(please tick)* Sunny, Cloudy, Partly Cloudy, Rain, Snow.			
Temperature *(In Degree Celsius)*			
Type of Amphibian *(Adult, tadpole, newt, eggs)*	**Habitat Type** *(marsh, open field, water body, agriculture fields)*	**Number**	**Behavior observed** *(feeding, mating, nesting)*

Amphibian Field Journal

1. Note location, date and time: You will want to be able to look back at your nature journal and know exactly when and where you were when you observed each entry.

Location Date/Time

2. Record your observations with drawings/sketches. Note its size, colour, and habitat. Take photographs (optional) for identification purpose.

3. Describe the scenario in your own words and add how you felt at the time of observation. What are its adaptation features? Is it a predator or a prey to which animal?

4. Write down any other observations and issues that you noticed.

Activity 10
Butterfly Quest

Background information

Insects are essential links at the lowest levels of the food chain. These insects or lapidopetras (meaning scale wings, referring to the minute scale-like structures on the wings of both butterflies and moths) play an important role in the various ecosystems and form a significant part of the food chain in the ecology. Since they have specific ecological needs, sensitive to climate change, they are also great indicators of change in the wetland and climate.

Searching for Butterflies, one of the most beautiful insects, will entail exploring around the narrow valleys and wooded areas.

Did you know?

- Butterflies have four life cycles: egg, larva (caterpillar), pupa (chryslis), and adult.
- Butterflies attach their eggs to leaves with a special glue like chemical.
- There is an estimated 5000 to 20,000 different butterfly species world- wide.
- Second to bees, butterflies help in pollination and therefore are vital to creating our food sources.
- Ludlow's Bhutan Swallotail is the National Butterfly of Bhutan and it is an endemic **species (found only in Bhutan).**

Materials needed:

- Hand-held magnifying glass, wet boots, hat, camera (optional), butterfly guide book, GPS(optional), maps (optional).

Time required:

- Two to three hours for field excursion

Objectives:

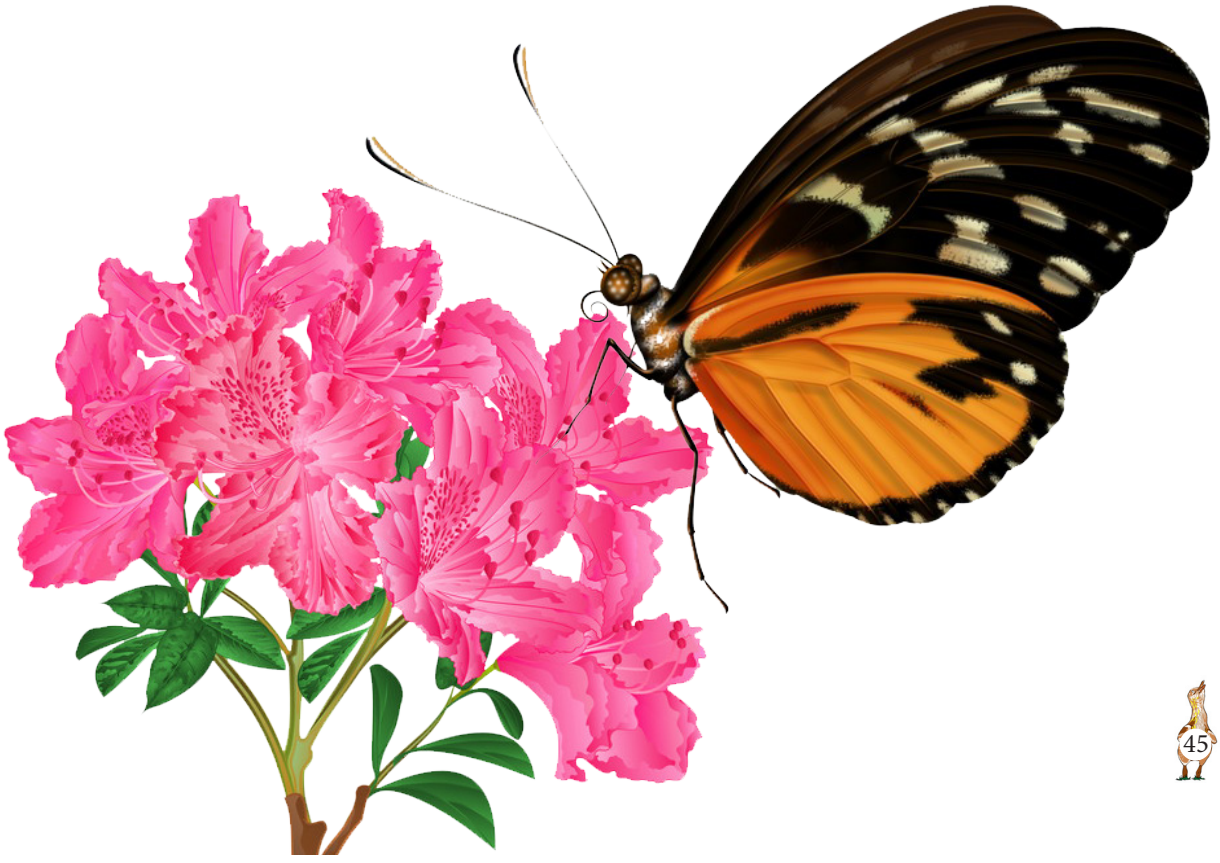
- Learn to identify butterflies and differentiate between a moth and a butterfly
- Connect to the natural wonders of the butterfly world
- Learn about their role in the ecosystem

Activity process:

- Make a visual presentation on Gantey-Phobjikha, its natural and cultural heritage with specific focus on the butterflies of the valley.
- Brief participants on the dos and don'ts and basic etiquettes to follow while in the valley and on the butterfly quest.
- Hand out butterfly record sheets and a reference checklist along with tips to spot butterflies on the guided walk.
- Lead participants through the designated nature trails and boardwalks in search of butterflies.
- The walk should include places where butterflies are likely to be found including wildflower fields, open meadows, stream side, marshes, hilltops, and forests.
- Ask each individual to keep a close look out on flower heads, blades of grass, leaves of shrubs and trees, and moist ground.
- Before turning to the field guide on butterflies, ask the participants to check for clues such as its size, colour and shape of the wings, its posture when perched, flight pattern and behavior (mating, nectaring, perching, basking etc).
- Ask participants to identify the butterflies using the guidebook and record information in the sheet provided.
- Walk back to the classroom and ask the participants to discuss experiences and learning outcomes.
- Ask participants to hand over the record sheets or enter data into their butterfly data base.
- Journaling is an option for participants. Hand out journal sheets to interested individuals to write down the events of the day.

Recommendations:

- Presentation on Butterflies of Gangtey-Phobjikha (include: differences between a butterfly and a moth, how to spot butterflies, importance of butterflies in the ecosystem)
- Butterflies of Gangtey-Phobjikha, by RSPN
- Butterfly checklist
- Butterfly record sheet



Butterfly Record Sheet

Site Name:			
Date (DD/MM/YY):	Season: Spring Summer, Autumn Winter		
Weather Code: (please tick) Sunny, Cloudy, Partly Cloudy, Rain, Snow			
Temperature (In Degree Celsius)			
		Behavior observed	**Habitat type** *(Woodland, marsh, open field, agriculture field, marsh, stream)*
Common Name	**Scientific Name**	*(feeding, flight, basking, mating, nesting)*	

Butterfly Field Journal

1. Note location, date and time: You'll want to be able to look back at your nature journal and know exactly when and where you were when you observed each entry.

Location Date/Time

2. Record your observations of the butterflies with drawings/sketches. Note its colour, size, behavior, stage (larva, pupa or adult).

3. Describe the butterfly in your own words and add how you felt at the time of observation. Describe its habitat, colour, size, behavior, and other distinguishing features. Is it a predator or a prey to what animal? What other roles does it have in the ecosystem?

4. Write down any other observations and issues that you noticed.

11 Activity
Sensing the Wetland

By now we know a little about wetlands and what they provide in terms of basic necessities such as food, water, home and safe cover for a lot of wildlife and people. We can learn about wetlands by feeling mud, leaves from plants, shells from insects, and other items. This activity is appropriate for children and introduces them to the wetland's wide array of plant and animal community and builds a basic understanding of the ecosystem services wetlands provide.

Equipment needed:
- Wet boots, rain gear, hand held magnifying glass.

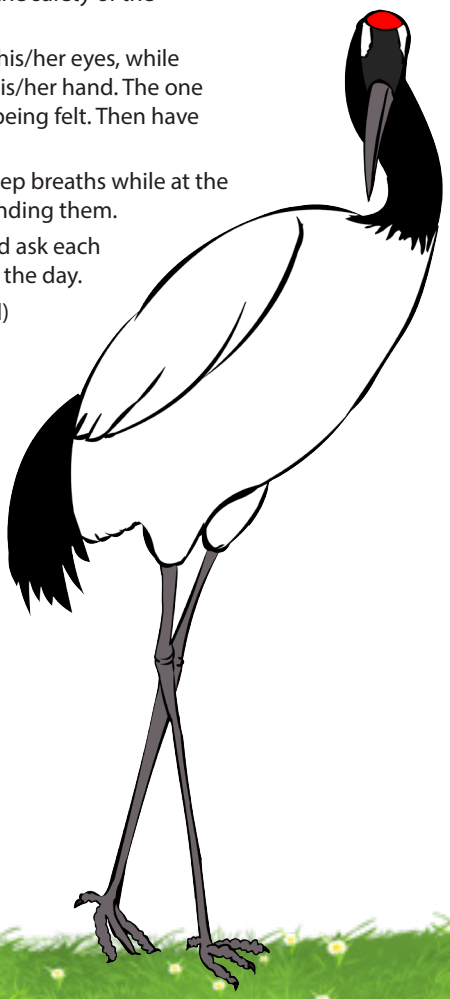
Time Required:
- One to two hours

Objective(s):
- Experience and learn about the wetland using four sense organs.

Keywords:
- Nurturing, ecosystems, journal.

Activity Process:

- Brief the participants on the do's and don'ts especially to inculcate a sense of responsibility toward nature and for the safety of the participants in the wetland.
- Have the group to pair up and ask one to close his/her eyes, while the other places something from a wetland in his/her hand. The one holding the item then tries to describe what is being felt. Then have them switch and use a different item.
- Have them to close their eyes and take a few deep breaths while at the wetland. Ask them to describe the smell surrounding them.
- After the activity walk back to the classroom and ask each member to write their journals on the events of the day.
- View videos on the wetland and crane.(optional)



12 Activity
Wetland Water Monitoring

Background information

Water is essential to human life and to the health of the environment. It basically has two dimensions that are closely linked - quantity and quality. Water quantity is the amount or volume of water, which can be physically measured using simple tools and formulas. Water quality is commonly defined by its physical, chemical and biological characteristics.

Good water quality is an asset to the wetland and vital for many plants and animals that depend on it including human beings. A healthy water ecosystem is one in which the water quality supports a rich and varied community of organism and can be utilized by people (domestic, recreational and economic uses) without having to treat it artificially.

What affects the quality of Water?

Water quality is closely linked to and influenced by the surrounding environment, land use and activities such as agriculture practices, cottage industries, waste management systems, and recreation. Weather also can have a major impact on water quality and quantity.

Monitoring changes in water can tell us if the water is polluted or where the pollution comes from. In the long term, water monitoring can help determine action toward conserving the wetland and its waters.

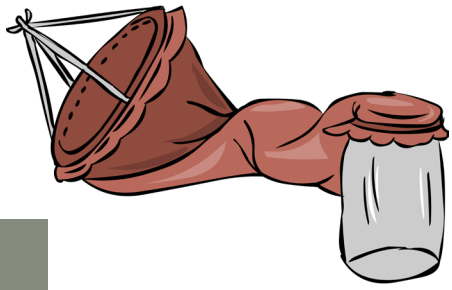
How is water quality measurable?

The presence of contaminants and the characteristics of water are used to indicate the quality of water. Measurements of these indicators can be used to determine and monitor changes in water quality and determine whether the quality of the water is suitable for the health of the natural environment and for human consumption. There are essentially four ways to measure water quality:

- Physical: temperature, turbidity and clarity, color, salinity, suspended solids and dissolved solids.
- Chemical: pH, dissolved oxygen, biological oxygen demand, nutrients (nitrogen and phosphorus), organic and inorganic compounds.
- Biological: bacteria, algae, benthic macroinvertebrate
- Aesthetic: odors, taints, color, floating matter

Did you Know

- Less than one percent of the earth's total water supply is suitable for drinking. Most of the earth's water is in the oceans or polar ice caps.
- Most of the rain water that falls to earth returns to the atmosphere through evaporation and transpiration, when the cycle is repeated.



Objective(s):

- Learn about different properties and how they affect water quality
- Learn the basic skills to monitoring water quality and analyzing results

Keywords:

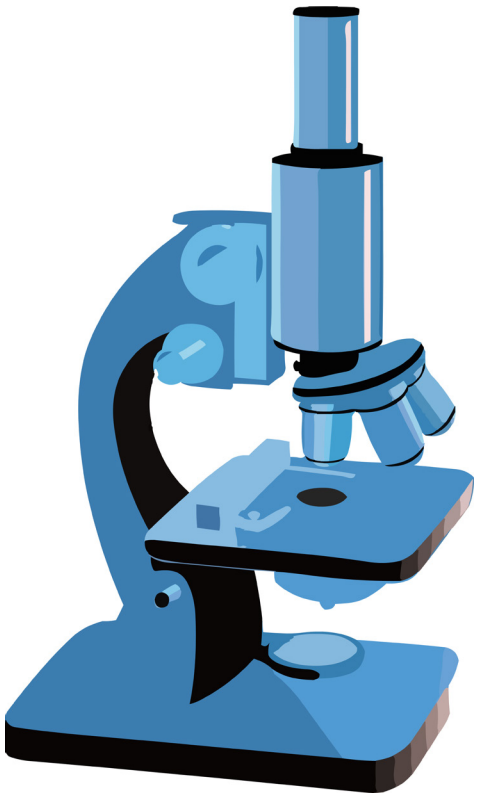
- benthic, salinity, aesthetic.

Equipment needed:

- Measuring tape, depth measure tube, thermometer, turbidity tube, sample bottle, pH kit, pencils/pens, wetboots, camera, magnifyig glass.

Time Required:

- Thirty minutes to one hour guided water testing activity in the field.

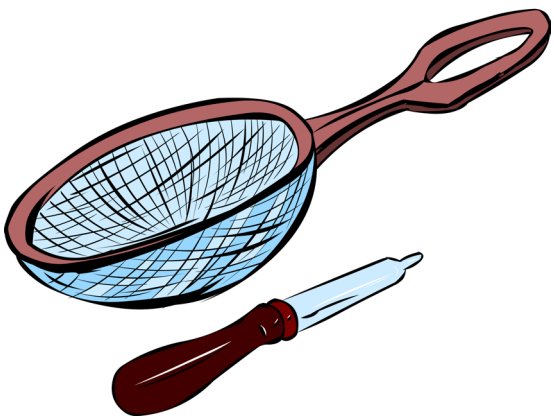


Activity Process:

- Conduct a short presentation on the ecology and culture of Gantey-Phobjikha valley with specific focus on the wetland, water and issues in the valley.
- The presentation should also include dos and don'ts, other basic etiquettes and safety measure while in the valley.
- After the orientation, lead the group to designated sites to carry out water tests.
- Ask each group or individual to record test results in the record sheets.
- If it is a large group, divide them into three so each group can carry out the physical, chemical and biological tests.
- Gather back to discuss and analyze the results.

Recommended materials and prerequisites:

- Water Test indicator/analysis sheets
- Record sheets
- Journal



Interpreting Water Quality Data

Observation	Possible Associated Causes
Decrease in Dissolved Oxygen (DO) Less than 5 mg/l (normal range: 5-8 mg/l)	• Reduction in vegetation • Increase in sediment or suspended solids; • Leaking or failing septic systems • Waste from farms and animals • Garbage • Agricultural runoff • Multiple sources of water pollution (e.g., chemicals, toxins) • Climatic or weather change
Presence of Fecal Coliform Bacteria	• Sewage • Animal droppings • Dairy and feedlot contamination
Increase in Temperature (normal range: 2-20^{0}C)	• Urbanization leading to increased numbers of buildings, homes, and roads on lands, that previously were natural areas and absorbed rain and snow melt more efficiently • Removal of stream side vegetation; overgrazing; poor farming practices and construction causing excessive soil erosion • Climate Change
Hight Turbidity More than 80 JTU (Normal range: 25-80 JTU	• Construction sites (road, houses) • Erosion of soil from cleared land • Algae bloom
Excessive Phosphates More than 0.1 ppm (normal range: 0-0.1 ppm)	• Fertilizers and pesticides • Detergents • Raw sewage entering waterways
Excessive Nitrates More than 5 ppm (normal range: 0-5 ppm)	• Fertilizers and pesticides • Leaking or failing septic systems and sewage treatment facilities • Improper waste disposal • Cottage industry wastes and chemical run off
pH Level Less than 5.5 (normal range: 6.5-8.5)	• Improper or failing sewage plants • Agricultural fields • Cottage industry wastes and chemical run off
High conductivity	• Failing sewage systems • High temperature • Water used for irrigation • Discharge of heavy metals into the water
Low conductivity	• Oil/grease spill • Low temperature
Excessive Ammonia Normal range 0-0.05 mg/l	• Fertilizers • Pesticides • Failing sewage

Water Quality Record Sheet

Location:			
Date (DD/MM/YY):		Start Time:	End Time:
Weather Code: *(please tick)* Sunny, Cloudy, Partly Cloudy, Raining, Snowing			
Temperature *(In Degree Celsius):*			
Please record data in the table below.			
Parameter	**Unit**	**Measurement**	**Remark**
Temperature	Degree C		
Dissolved Oxygen (DO)	Mg/L		
pH level	ppt		
Turbidity	JTU		
Faecal Coliform	CFU/L		
Phosphates	Mg/L		
Nitrates	Mg/L		
Ammonia	Mg/L		
Other observations:			

Stream Water Monitoring Journal

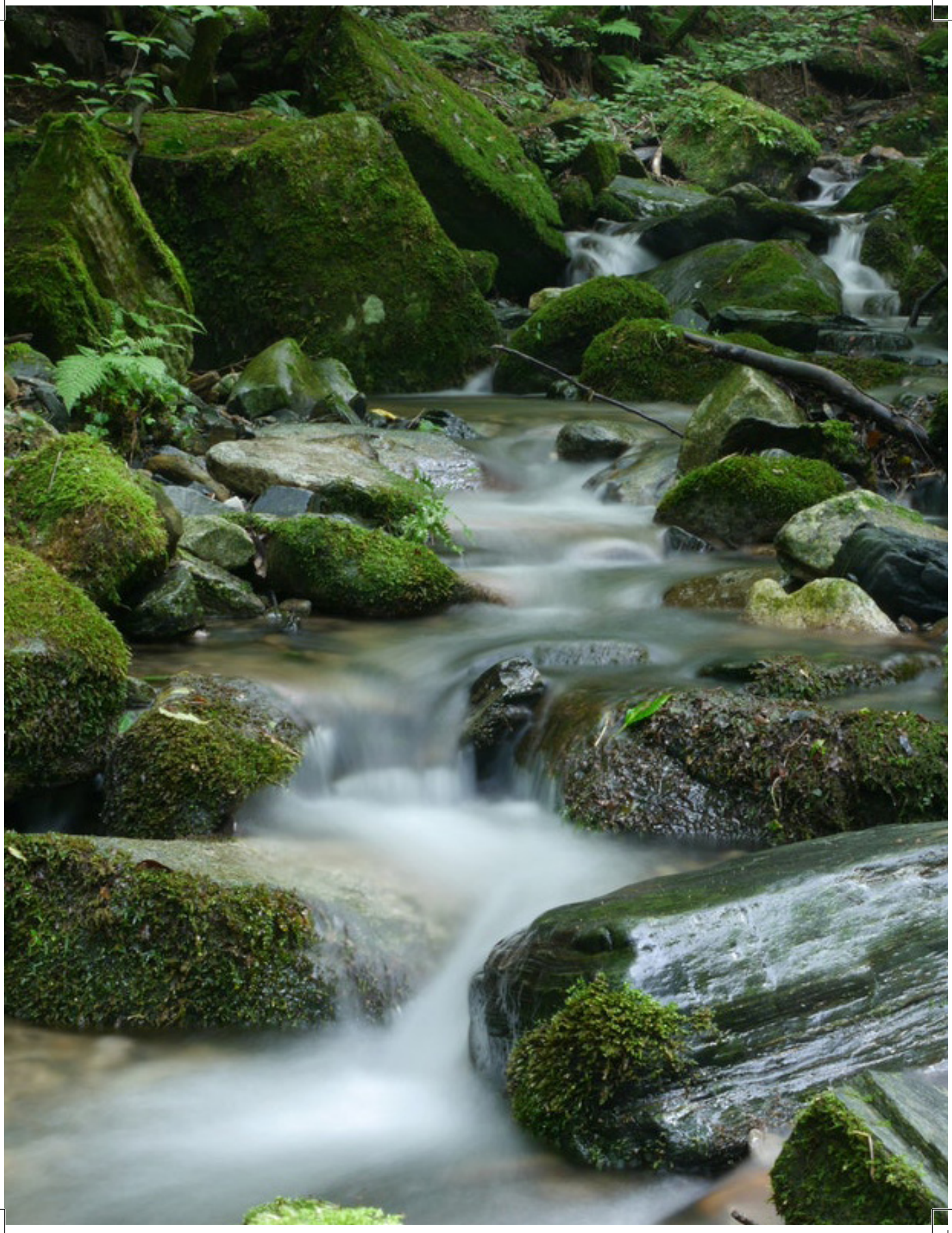
1. Note location, date and time:

Location Date/Time

2. Record your observations with drawings/sketches of streams and nearby vegetation.

3. Describe the stream, its vegetation, aquatic life, and water quality such as velocity, turbidity, temperature, DO, pH level etc. Do you think this water is healthy? Why? (What are the probable causes affecting water quality? Describe pollutant sources if there are any).

4. Write down any other observations and issues that you noticed.



13 Activity
Stream Hydrology

Background

It is important to look at the flow patterns such as speed or velocity, depth and other physical characteristics of the streams to understand water quality and its relationship to the wetland habitat and watershed.

Stream velocity: is the measure of water speed and a fast-moving stream which give the water the force to scour the stream bottom and banks and pick up sediment and the material. Some organisms like algae cannot live in a stream or stream section that is moving at high velocity.

Stream width: Stream width influences the growth of vegetation along its sides thereby influencing water temperatures.

Stream depth: Stream depth determines how much sunlight reaches the stream bottom, which in turn determines whether organisms that require light, such as algae, can grow there.

Stream discharge: is the total volume of water in the stream and is influenced by the width, depth and velocity. Two streams of similar size may have quite different discharges if the flow of velocity differs.

Equipment needed:

- A small floating device such as light wood or dried cone, stopwatch, measuring tape or survey rod., long string, a metre stick, a stop watch, and note book.
-

Time required:

- One to two hours at the stream side

Objective(s):

- Be able to measure physical river parameters like water depth, stream velocity, temperature and dissolved oxygen
- Discuss interactions between flow patterns, temperature and oxygen

Keywords:

- Velocity, sediment, algae, hydrology, etiquette, stream depth, stream discharge.

Activity Process

- Conduct a short presentation on the ecology and culture of Gangtey-Phobjikha valley with specific focus on the wetland, water and issues in the valley.
- Include dos and don'ts, other basic etiquettes and safety measure while in the valley.
- Lead the group to designated sites to carry out basic hydrology tests
- Mark a 15 to 20 feet section of a stream choosing a portion that is relatively straight and with less vegetation or obstructions.
- Tip: Avoid areas with artificial structures such as a bridge because those structures will modify the true flow.

Volume and Velocity

Knowing how to find the volume of flow of a river and its velocity is a skill needed by many professionals and important for all sectors. How can you do this? It is simple and fun!

Volume

(To calculate the volume of the stream, you also have to calculate the velocity)

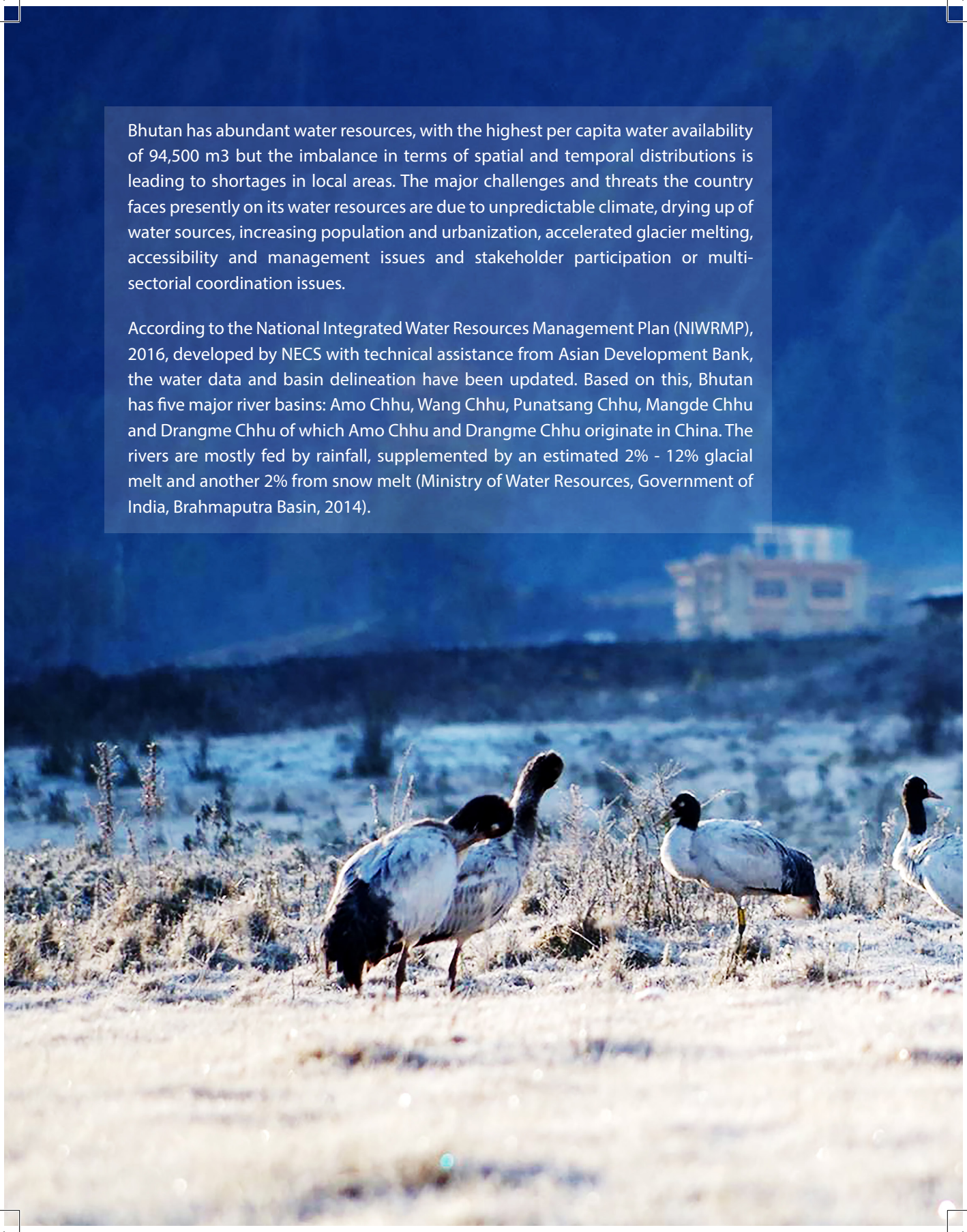
1. Visit the banks of a stream, preferably on sunny day. Put the string across the stream suspended between two sticks
2. Record the depth of the channel every 10 or 20 centimeters along the string.
3. From this measurement calculate the cross-sectional area of the stream. You can plot the information on a graph.
4. To calculate the flow velocity of the stream, choose an area where the river flows in a straight line without any obstacles such as bridge or with curves. Measure a distance of 10 meters downstream and mark this point with a stone or wood at both ends.
5. One of your friends can stand at the upstream point and throw a light wood or dried cone into the stream. In order to get a precise reading it is better to throw the object a little above the 10 meters starting point. You should start the watch the moment the object passes the start point and stop it at the end point.
6. You can calculate the speed of the stream in meters per second by dividing the distance by number of seconds (i.e 10 meters / Time (in seconds) taken to cover the distance).

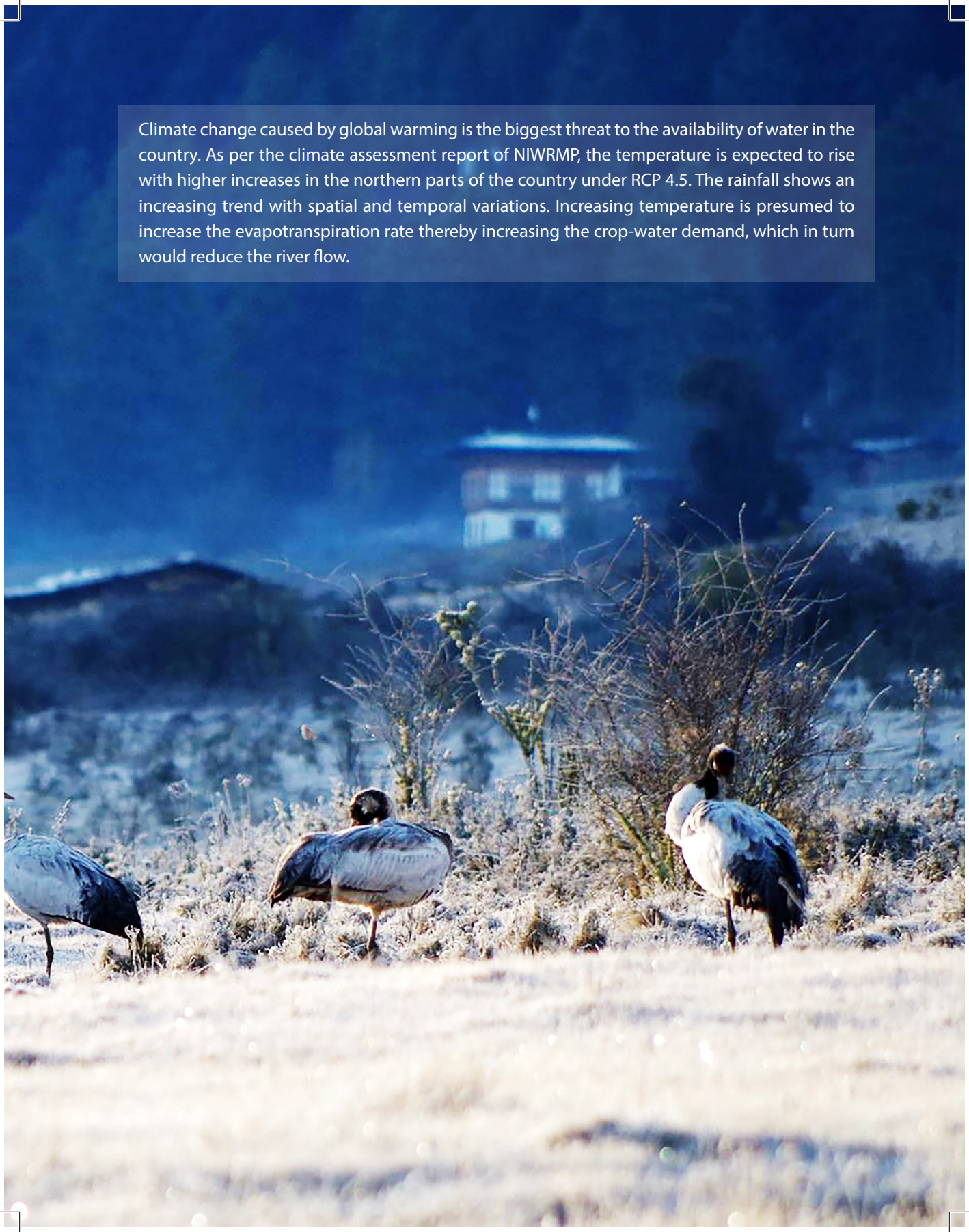
Now calculate the volume of flow of the stream by:

7. Velocity of the water X Cross Sectional Area (no. 3 above). You will get the volume in cubic meters per second.

Bhutan has abundant water resources, with the highest per capita water availability of 94,500 m3 but the imbalance in terms of spatial and temporal distributions is leading to shortages in local areas. The major challenges and threats the country faces presently on its water resources are due to unpredictable climate, drying up of water sources, increasing population and urbanization, accelerated glacier melting, accessibility and management issues and stakeholder participation or multi-sectorial coordination issues.

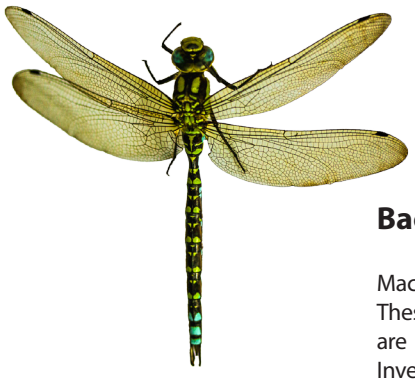
According to the National Integrated Water Resources Management Plan (NIWRMP), 2016, developed by NECS with technical assistance from Asian Development Bank, the water data and basin delineation have been updated. Based on this, Bhutan has five major river basins: Amo Chhu, Wang Chhu, Punatsang Chhu, Mangde Chhu and Drangme Chhu of which Amo Chhu and Drangme Chhu originate in China. The rivers are mostly fed by rainfall, supplemented by an estimated 2% - 12% glacial melt and another 2% from snow melt (Ministry of Water Resources, Government of India, Brahmaputra Basin, 2014).





Climate change caused by global warming is the biggest threat to the availability of water in the country. As per the climate assessment report of NIWRMP, the temperature is expected to rise with higher increases in the northern parts of the country under RCP 4.5. The rainfall shows an increasing trend with spatial and temporal variations. Increasing temperature is presumed to increase the evapotranspiration rate thereby increasing the crop-water demand, which in turn would reduce the river flow.

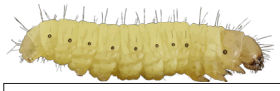
14 Activity
Aquatic Macroinvertebrate Survey

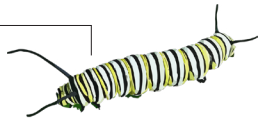


Background Information

Macroinvertebrates are organisms without backbones (invertebrate). These creatures tell us a great deal about the quality of water beacuse they are intolerant to polluted water and can be easily detected and sampled. Invertibrates that are retained on a 0.25mm mesh net are generally termed macro invertebrates. Aquatic macroinvertebrates include nymphs, stonefly nymphs, dragonfly larvae, midge larvae, crayfish, leeches, aquatic worms, and water beetles. They live all of part of their lives in water.

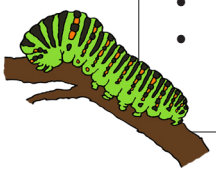
In Bhutan, a Relict species of dragonfly larvae, Epiophlebia laidlawi, was discovered in the head waters of Dreychhu in Dechenchholing, Thimphu and in Lanchelachuu in Chendebji, Trongsa. The presence of this species indicate that tht water is prestine with no antropogenic impact.





Did you know?

- Dragonfly Larvae breathe using gills at the end of its abdomen, in other words it breathes from its bottom.
- A leech has exactly 34 body segments.
- All arthropods (insects, spiders and crustaceans) shed their outer shell during their growth.
- Macro invertebrates are often used to determine the health of a water body.
- The presence of pollution sensitive marcro invertebrates indicate that the water is healthy.

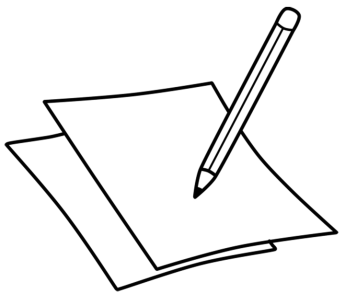


Equipment needed:

- Dip net with minimum 0.25mm, 250ml beaker, white enamel tray, blunt forceps, ink-dropper, magnifying glass, paper, pencil and a key for identification, dropper, pencil, note- book, spoon.

Time Required:

- One to two hours at the water testing location



Objective(s):

- Learn to identify aquatic macro in vertebrates
- Learn water quality monitoring using these insects

Keywords:

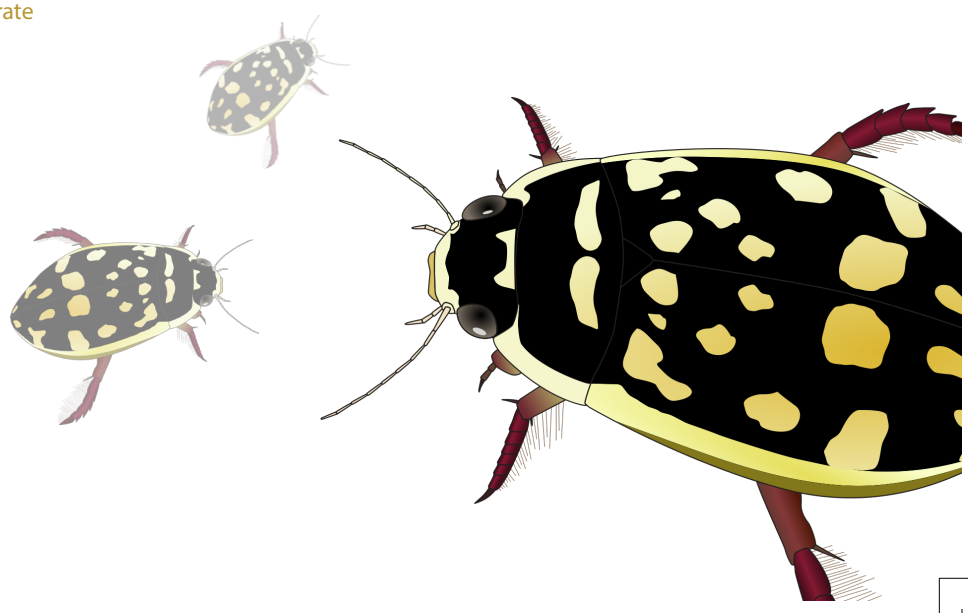
- Macro invertebrates, benthic, aquatic, contamination, arthropod.

Activity Process

- Select a water body that is to be studied.
- If in a group, divide into smaller groups and provide each group with a white tray and a net.
- Ask individuals to stand at the edge of the water body in such a way that water does not get disturbed. Next, ask them to put the net inside the water until it touches the bottom.
- Ask them to move the net inside the water from right to left once and immediately remove it out of water. The net will be filled with a number of small pebbles and stones along with the soil. Throw the stones and pebbles back in water and let them place the remaining matter on the white tray.
- Repeat the last process one more time.
- Take some water, and put it in the tray, which is holding the collected matter to keep the insects alive.
- Give them an empty, clean beaker half filled with clear water. Now, using forceps separate the insects or whichever animal is seen from the tray and put them inside the beaker.
- Once they are separate, using a magnifying glass ask them to observe the structure of the animal that is present inside the water, find out the different body parts and try to note it down.
- If possible, ask a group member to sketch a rough drawing or take a picture.
- Take the identification key, which gives the details of the animal body parts and discover the name of the animal if possible.
- Once the observation is over, see to it that they do not destruct or kill the animals. Release them back into the water because that is where they belong.
- Head back to further discuss what the group discovered.
- Refer the chart in the annexure to discuss pollution levels.
- Participants can fill out a journal (optional).

Recommended References

- Any guide to macroinvertebrate



Theory behind Biological Assessment using macroinvertebrates: Macroinvertebrates found depends on their sensitivity and tolerance to the level of pollution

No pollution to slight pollution

Macrointertebrates found in “Fair Quality” water are somewhat sensitive to pollution

Mayfly Beetle Adult New Caddisfly Damsfly

Moderate pollution

Macrointertebrates found in “Good Quality” water are sensitive to pollution

Dragon fly Prawn Crab Beetle larva Clam or Mussel

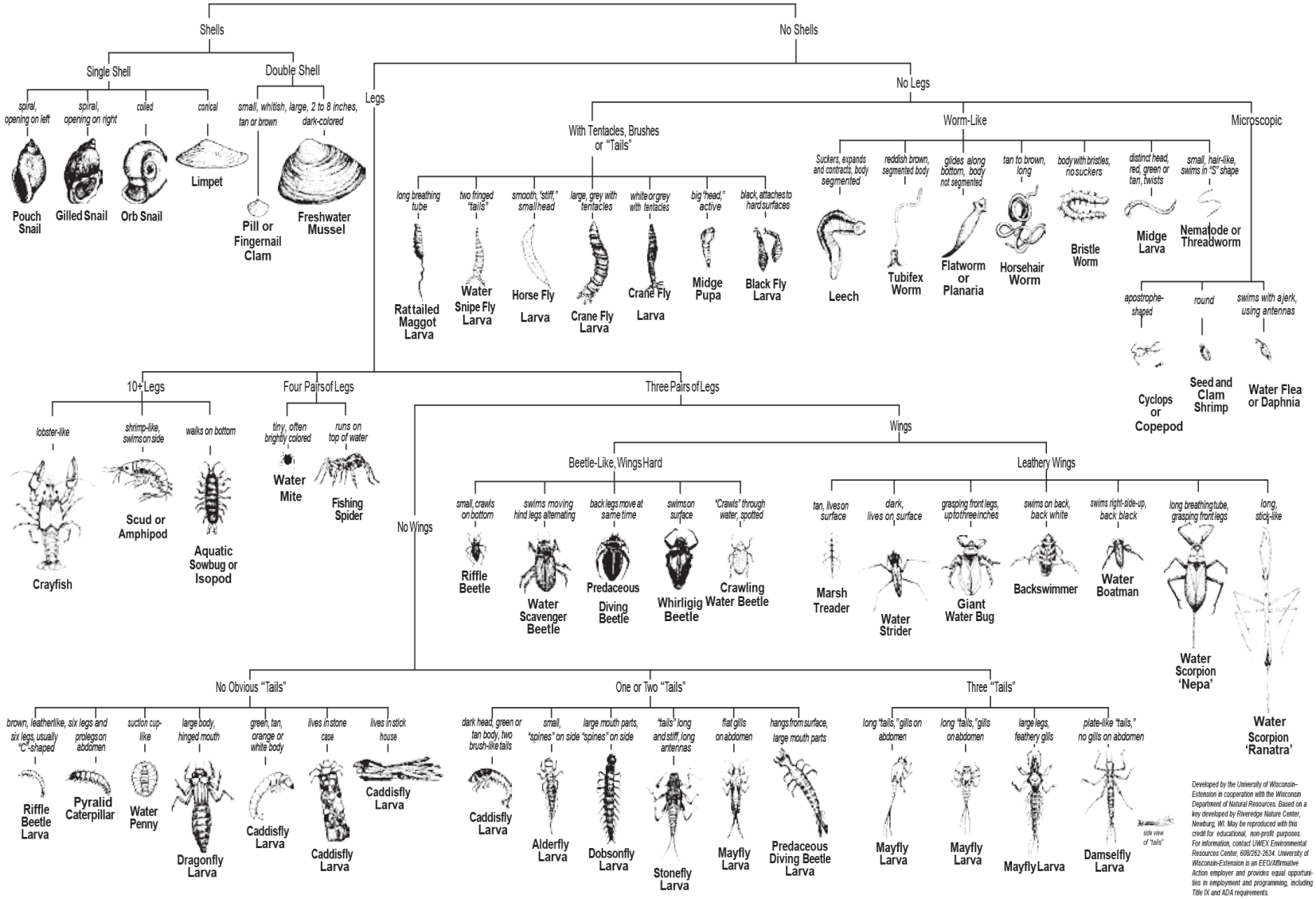
Severe pollution

Macrointertebrates found in “Bad Quality” water are tolerant to pollution

Corbicula Aquatic worm Brotia Leech Chironomous Snail

Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)



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Macroinvertebrate Field Journal

1. Note location, date and time:

Location

Date/Time

2. Record your observations of macroinvertebrates focusing on the size, shape, number of legs, wings and tails (if any).

3. Describe its features and habitat.

4. Write down any other observations and issues that you noticed.

15 Activity
Be a Soil Scientist for a Day

Background Information

Soil structure refers to the way soil particles are bound together into aggregates of different sizes and shapes. It determines the amount of air and water that may penetrate into the soil. This is important because a plant's ability to take root and grow to maturity is directly affected by the porosity of the soil. For instance, heavy or dense soils will reduce the flow of air, water and nutrients into the soil and result in a reduced ability of the plant to flourish.

Equipment needed:

- Wood block, beaker/jar, filter paper, funnel, dye, dried soil.

Time Required:

- Two to four hours at the water testing location

Activity Process:

- Keep dry soil samples ready at room temperature and ask participants to collect soils from different locations such as the forest, wetland and agricultural fields.
- Crush dried soil with a wood block or mortar and pestle to a fine powder.
- Place a 250 to 300 ml clear glass receiving vessel (glass tumbler or plastic drinking cup) inside the larger 500 ml glass (or plastic) beaker or jar.
- Place a filter paper inside a funnel and fill the funnel about 1/2 full with crushed soil.
- Place the funnel containing the crushed dry soil on top of the 500 ml beaker (or jar) such that the stem of funnel fits inside the smaller receiving vessel inside the beaker (or jar).
- Prepare the dye solution in the squirt bottle by mixing 10 grams of dye with 500 ml of tap water.
- Add to each soil in the funnel enough dye solution to wet the soil plus just a little extra.
- Wait about 10 minutes (may take longer for the clayey and organic rich soil) for the dye solution to filter through the soil.
- Remove the filtered dye solution that was caught in the receiving vessel inside the beaker and place it beside the soil used as a filtering medium.
- Note which soil was associated with the clearest solution collected. It should have been the clayey and organic enriched soils with the sandy soil having the least dye removed.
- Discuss why the dye filtered out more from some soils than other soils?
- Consider this principle in the remediation qualities of soils and their ability to buffer against chemical pollution and filter water percolating through soils. Also, consider the long-term clean up of soils polluted with chemicals.

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